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PDV Measurement of Vortical Structures in the DTMB Rotating Arm Facility

by
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Particle Displacement Velocimetry (PDV), a quantitative flow visualization technique, was implemented and utilized to study the wake of a captive model simulating a maneuvering submarine. From the resulting PDV images cross flow velocities are calculated with correlation technique. A number of vortical structures, associated with the hull, sail and sail planes are identified. These structures covered a wide range of both velocity and spatial scales. Several difficulties have been identified with the present system and recommendations are provided for future improvements in terms of data analysis efficiency and image resolution during image taking process.

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ABSTRACT

Particle Displacement Velocimetry (PDV), a quantitative flow visualization technique, was implemented and utilized to study the wake of a captive model simulating a maneuvering submarine. From the resulting PDV images, cross flow velocities are calculated with a correlation technique. A number of vortical structures, associated with the hull, sail and sail planes, are identified. These structures covered a wide range of both velocity and spatial scales. Several difficulties have been identified with the present system and recommendations are provided for future improvements in data analysis efficiency and image resolution during image taking process.

ADMINISTRATIVE INFORMATION

This work was performed at the Carderock Division, Naval Surface Warfare Center, Bethesda, MD 20084. The experimental portion of the project was funded by the Defence Advanced Research Projects Agency (DARPA) Submarine Technology Program under Element No. 63569E, Task area S1974030, and David Taylor Research Center (DTRC) FY90 Work Unit Number 1-1501-020-22. The analysis portion of the project, reported herein, is from Draper Laboratory, Purchase Order DL-H-454814 of July 20, 1993, and David Taylor Model Basin (DTMB) Work Unit Numbers 1-5000-017-31 and 1-5000-017-32.

INTRODUCTION

The Navy has always been interested in developing and broadening their capabilities on the hydrodynamics of vehicles moving in water, especially submersibles. There is a great need for information to aid in the design of and in the safe maneuverering and control of ships. The range of specific topics required are quite different depending on the mission of those vehicles. One of the major Navy efforts in the past decade is the understanding of the physics of unsteady shedding of vortices from all control surfaces and their effect on the force/moment contribution to the hull and the propulsor. Unsteady propeller forces are the origin of significant ship vibration and radiated noise. The importance of a "quiet" ship is in every designer's mind and is one of the objectives of DARPA.

ARPA's Submarine Technology Program has funded extensive studies of the flow around submarines, both theoretical and experimental. Advanced computer codes, such as the RANS code, have demonstrated the capability to predict the flow around submarines with some success. Current methods use historic data on hydrodynamic coefficients and are reasonably good when the model configurations are within the data base. This is mostly true for models in straight line motion. During maneuvers, when the submarine moves at incidence, the flow on the main hull separates, creating a pair of large body vortex structures in its lee side. In addition, depending on the side-slip angle, a tip vortex can be generated on the sail. The various trailing flow structures then interact with each other and create an asymmetric, complex, three dimensional wake. This flow results in adverse out-of-plane forces and moments. The complexity of the flow around a maneuvering submarine is one of the major difficulties to those who attempt to predict the flow. This problem is magnified by a lack of experimental quantitative information that can serve as a data base for predictions and computations. Generation of such fundamental information on the evolution with time of the vortical structures around a maneuvering submarine is the focus of various DARPA tasks.

Extensive steady captive model tests in a straight line towing tank and the rotating arm tank were conducted to build up the data bank information. Additionally, with the development of Particle Displacement Velocimetry (PDV) technology, DARPA planned this unique test to measure the flow field and the force/moment data concurrently. PDV is capable of providing detailed maps

of the instantaneous velocity distribution in a plane of a flow field. It was first developed and utilized in the study of small scale flows, with a typical field of view of 0.1 m (4 inches), in small test facilities. Recent work in the 140-ft basin at David Taylor Model Basin has used PDV techniques to measure flow phenomena at somewhat larger scales (~0.3 m field of view). Examples of this work include Shekarris[1] et al. who studied the near-field behavior of a tip vortex generated by the sail of a submarine at incidence and Fu[2] who examined the separated flow around a 6:1 prolate spheroid. In these cases the model lengths were 3 m (9.8 ft) and 1.4 m (4.6 ft), respectively. The area of dominant vortical flow structure for both tests was up to 0.3 x 0.3 m (1 x 1 ft).

Based on the success of these earlier tests, the decision was made to develop a PDV system capable of making detailed measurements in DTMB's large towing tanks and Rotating Arm facilities where the dominant flow structures often exceed 1 x 1 m (3 x 3 ft). Although it was not intended to be a production run for the flow around the model, six model pitch/yaw settings for three model configurations were attempted to explore the feasibility of the PDV technique in a large towing tank. This report presents the results of this exercise. It is understood that the test plan was set to explore the breadth of PDV capability rather than the depth of each individual test condition. Therefore, not all instrumentations are in their optimum arrangement. The results presented for each model configurations were preliminary in nature. Further experiments are necessary in order to derive more conclusive flow field results for a turning model.

STUDIES OF A TURNING BODY

During a maneuver the submarine is, in general, at some angle of attack. Forces and moments are generated on the hull from various appendages as well as the hull itself. Typically, the flow separates on the lee side of the hull and shed vorticity rolls up into a pair of body vortices. The sail introduces a strong tip vortex. Other control surfaces also at local angle of attack, develop lift and circulation and shed trailing vortices. Each vortex trails aft along the hull and causes the surrounding fluid to swirl around it. Thus, each vortex influences the path and the corresponding strength of all the other vortices. Features[3] affecting the behavior of a submarine during turning can be simplified to consider only : (1) velocity variations along the hull during a turn due to the addition of the angular velocity; (2) the lift developed on the fairwater and control appendages, as a consequence, sail vorticity of varying strength is shed and convected downstream along the hull and interacts with the stern appendages; (3) a rolling moment is induced on the stern appendages during turning. This moment is partly due to vorticity shed from the bridge fairwater and partly due to differential lift caused by the masking effect of the submarine hull on the leeward side of appendages. This turning problem attracts attention not only from the hydrodynamic community but also those from the aerodynamic community for its obvious interest in maneuvering an aircraft. Extensive studies, both theoretical and experimental, have been conducted to reveal this complicated problem. Recently, with the advances in Computational Fluid Dynamics (CFD) capability, some maneuvering flow insight can be visualized through computer simulations. However, there is still a need to define a few key parameters, such as the flow separation angles and lines on the body, in order to carry out the computation[4,5] .

Lloyd[6] reviews the theoretical progress on predicting submarine maneuvers and listed three approaches: (1) define all the linear coefficients in six degrees of freedom from the captive tests such as towing tank and rotating arm, and planar motion mechanism techniques; (2) use a radio controlled model to measure maneuvering performance directly; and (3) calculate the hydrodynamic forces and moments directly from knowledge of the flow field around the submarine. The first two methods have been widely used in most maneuvering predictions. With the availability of faster and larger computers, there is greater interest, in the more economical and timely prediction of the forces/moments directly from the flow field generated by a turning model, such as the approach used by Hong[4,5]. The flow model, presented by Lloyd, employs a mixture of empirical methods

and classical hydrodynamic techniques to formulate the velocities and accelerations experienced by the model and the various vortex interference phenomena. A detailed description of the formulation for Lloyd's program can be found in his paper[6].

An attempt was made in the present research program to conduct the traditional rotating arm captive tests with the instantaneous flow field measurements by PDV. It is hoped to establish the link between these two different approaches.

MODEL SETUP AND INSTRUMENTATION

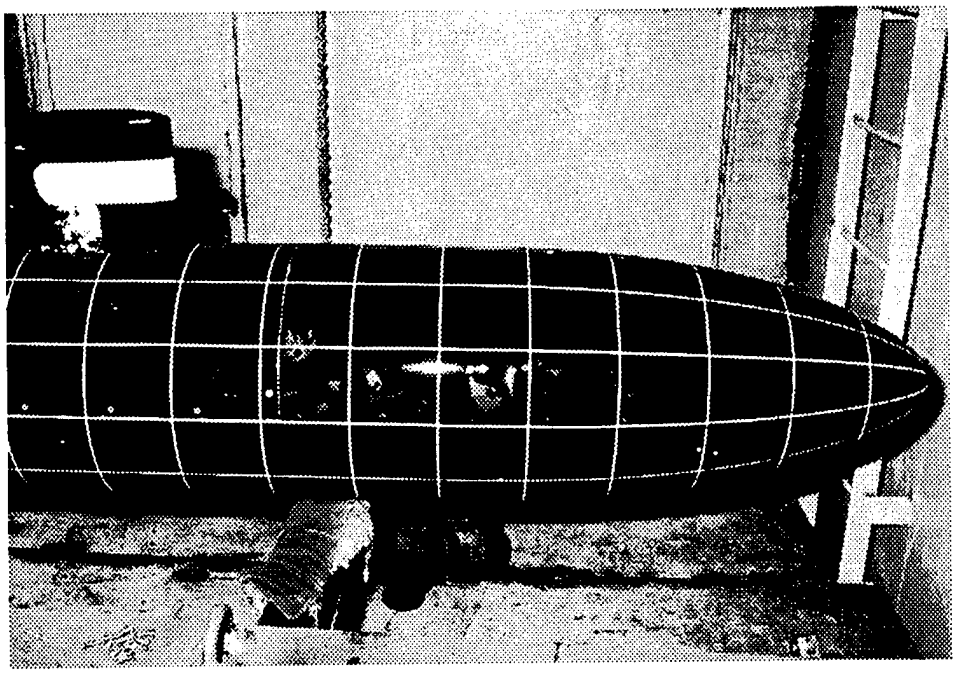
The model used in the investigation is Model 5484, Fig. 1. The description of the model and its appendages can be found in the DARPA Rotating Arm Phase II report[7]. The model is towed at a nominal speed of 5 knots for the entire test program. This sting-mounted model is attached underneath the turning table on the Rotating Arm towing carriage. The PDV instrumentation platform is a free standing structure positioned off the pedestal of the Rotating Arm's turning column. Due to the requirement demanded in the test plan, the closest position that laser sheet can be set for the test corresponds to the turning radius of 24.08 ft (r'= L/r=0.706). The farther most position that the light sheet can reach without moving the instrumentation platform is for turning radius of 26.30 ft (r'=0.646). Figure 2 shows the plan view of one of the experimental arrangements. Detailed description of the instrument platform, laser/optics and the camera can be found in Reference 7. For every model configuration tested, both laser sheet and the cameras are required to be adjusted. Since the images are gathered with respect to the physical tank coordinates, transformation to the model coordinate system is necessary. All the data presented in the report are based on the model coordinate system. In order to provide the perspective views of the model setup and its relationship to the tank, Appendix A contains the model arrangements for all the configurations tested. One can notice the change of the model orientation for different model yaw and pitch arrangements. The relationship of the final coordinate system, (X,Y) to that of basin (X_{basin},Y_{basin}) and laser light sheet (X_{sheet},Y_{sheet}) are presented in Fig. D-1.

PDV IMAGE ANALYSIS

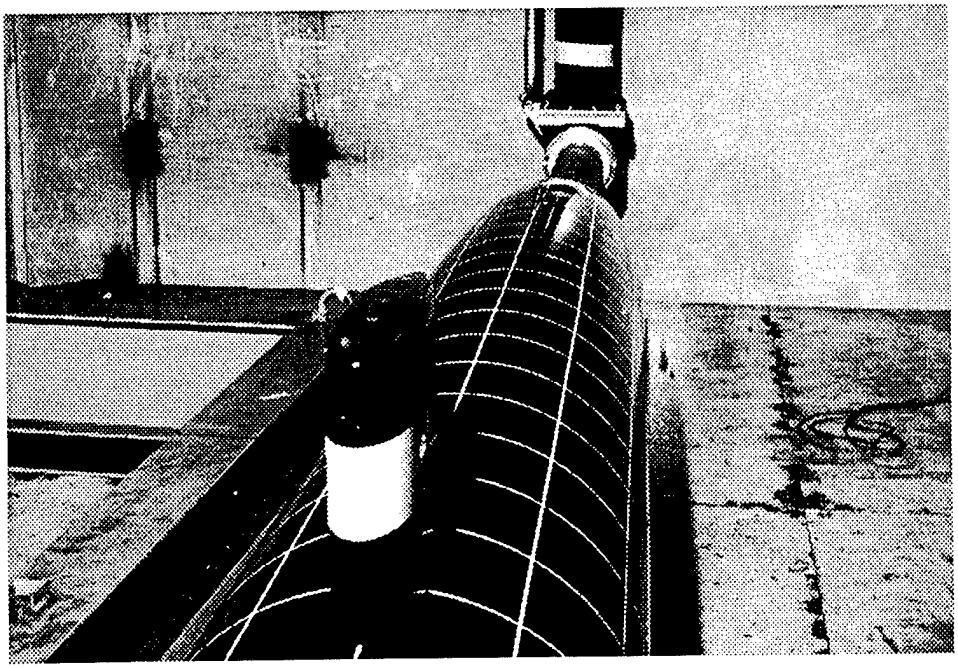
The PDV images collected during the tests are digitized and analyzed to obtain quantitative flow information including velocity vectors, vorticities and circulations. A good review of the PDV technology (or termed as Particle Image Velocimetry, PIV) can be found in Adrian's papers (References 8,9). The fundamental principles on which the analysis is based are given in References 2 and 10. In brief, the computation procedure searches for the mean correlation pattern among all particle images in a given local area. Typically, this local searching area is about 2.5 mm^2 (0.1 $inch^2$) physical scale. If a satisfactory correlation pattern is found, then a velocity is assigned to the center of the search area. Otherwise, the velocity of that area is left as null. The reason that a correlation is not obtained in certain regions could be caused by a lack of seeding or a low seed density as particles are swept away by a strong axial flow component, such as the cases where particles are near the vortex center or near the body.

The acquired flow images can be divided into two groups based on the nature of the image: images used as for flow visualization and those used for velocimetry. The difference is in the timing pattern of the laser. For a longer laser light exposure, those particle images become streaks showing the stream line of the flow. Here ordinary flow visualization but with much higher resolution can be obtained. With a short timing, in the order of one to two milliseconds, particle images can be resolved for the precise motion of the particle. Both the still camera and video tapes are analyzed to yield the migration of the vortex centers.

Table 1 shows the test matrix and Table 2 presents those images that are analyzed for the present report. Multiple entries for the same test condition indicate different images taken from different cameras (for different x/L locations). As seen in the table, there are no analyzable images



(1a) Front portion of Model 5484.



(1b) Model 5484 looking aft showing support strut and sting.

Figure 1 Model 5484

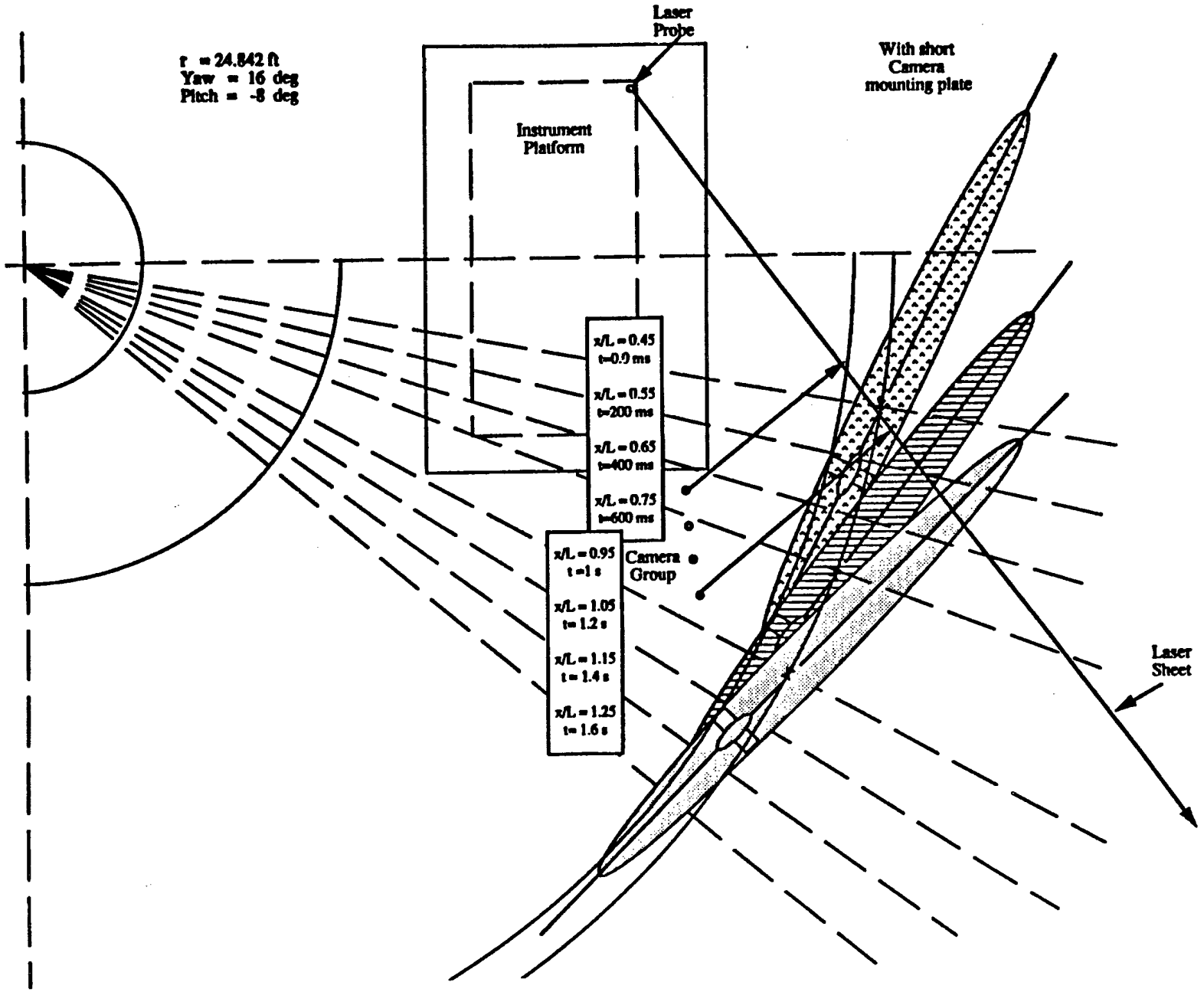


Figure 2 Plan view of the Rotating Arm Basin, instrumentation platform, and model orientation for yaw=16 deg. and pitch=-8 deg.

Table 1 Test Plan for the Force and PDV measurements

Model Configuration		PDV Images	Force Measurement
Bare Hull	Yaw	0, 8, 16	0, 4, 8, 12, 16
	Pitch	0, -8	4, 0, -4, -8, -12
	Roll	0	0
Sail + Hull	Yaw	0, 8, 16	0, 4, 8, 12, 16
	Pitch	0, -8	4, 0, -4, -8, -12
	Roll	0	0, 15, 30
Fully Appended	Yaw	0, 8, 16	0, 8, 16
	Pitch	0, -8	0, -4, -8, -12
	Roll	0	-15, 0, 15, 30

Table 2 PDV Images Analyzed

Model Configuration	Model Arrangement Yaw=0 Pitch=0	Yaw=0 Pitch=-8	Yaw=8 Pitch=0	Yaw=8 Pitch=-8	Yaw=16 Pitch=0	Yaw=16 Pitch=-8
Bare Hull	*1203102*		1204112	1204122	0101014	*1205112*
Sail + Hull	1212107		1211104	*1211120*	1209105	*1209113*
	1212207		1211204	*1211220*	*1209106*	*1209413*
	1212108		1211304	*1211320*		*1209114*
	1212208		*1211404*	*1211420*		*1209315*
Fully Appended	1122105	1125108	*1127111*	1127104	1108100	*1113100*
	1122106	*1125109*	*1127213*	1127204	*1108101*	*1113200*
	1122107		*1127214*	*1127105*	1108207	*1113101*
				1127205	*1108208*	

for model in Yaw=0 and Pitch=-8 degrees case. For those images that image analyses are performed, the quality of the images differs from case to case. Parameters that control the quality of the images include adequate seeding, proper laser light intensity, adequate laser pulsing pattern - the timing, focusing of the camera and the correct location of the camera view. For the present series of the tests, it was decided to cover all the vortical structures generated during maneuvering. This means to cover the vortices from the sailplanes, sail, hull body, and stern appendages. This objective thus required that the field of view cover not only a much larger physical space but also different time scales for different flow regions. With a turning model, the camera viewing area is set to cover a 1.22x1.22 meters (48x48 inches) physical space and the speed of a fraction of the towing speed to that of about the same magnitude. Because of this limitation, one averaged timing pattern is selected for the laser pulses in a given model configuration. Consequently, some higher speed flow regions show excessive light exposure while inadequate timing (sometimes no images) is the result in other slower flow regions. For the future tests, it would be ideal to break the large flow structures into a number of smaller sub regions for optimal results.

FLOW VECTORS

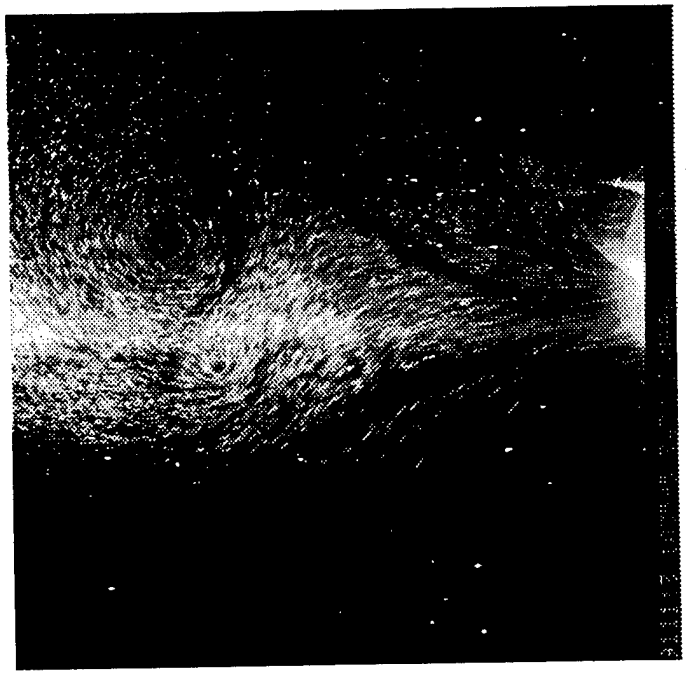
A typical set of flow pictures for a fully appended model arranged for three different roll conditions is shown in Fig. 3a at x/L=0.75 and Fig. 3b at x/L=1.25. Appendix B presents a collection of the pictures for three model configurations studied at x/L=0.75. A typical working image, showing different threshold treatments to the digitized data is shown in Fig. 4 for a fully appended model set for yaw=8 degrees and pitch=-8 degrees. The corresponding vector correlation results are shown in Fig. 5. The complete collection of all analyzed vector plots of the digitized images are summarized in Appendix C. The vector results are also tabulated in Appendix D giving the model X,Y location and the cross flow velocities. The orientation of the model coordinates to the basin coordinates is illustrated in Fig. D-1.

The vectors are the results from the correlation calculation. Particle images can be retrieved with various enhancement techniques. It can become a time consuming process for analysis of the entire picture. For the present report, only limited enhancements are employed. No attempts are made to recover all the particle images on the picture. If the images are of poor quality, either due to lack of seed particles or light, they are abandoned. Reduced vector plots in Appendix C show only those regions of the flow that can be readily analyzed. The rest of the regions are left blank. Consequently, only the major flow structures, such as the vortex flow, are shown with the analysis. These major structures are then used to compute the circulation.

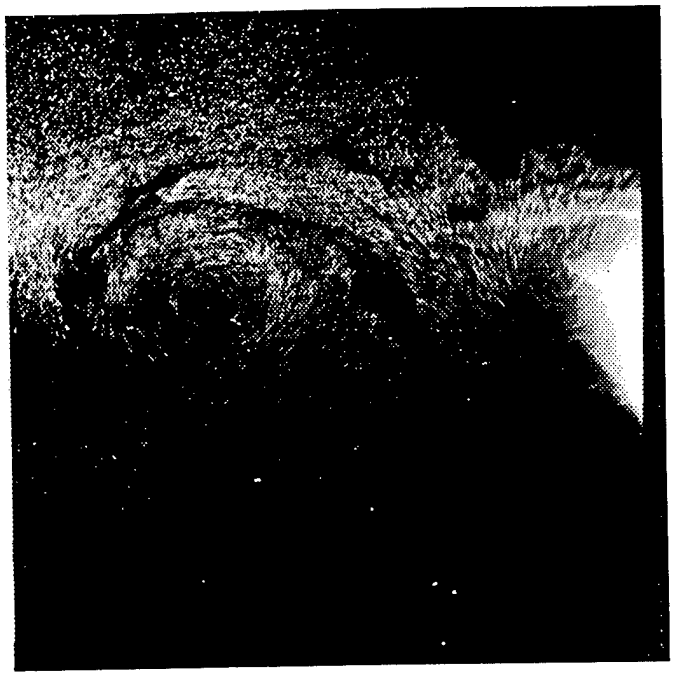
CIRCULATIONS

The reduced vector data are further analyzed for circulation calculation. The circulation calculation is performed by selecting an appropriate line integral path. Several paths are usually taken for each case. The area it enclosed, A, is a measure of how much of the vortical structure is included in the computation. Figure 6 presents the circulation calculations for Sail+Hull model configuration. The area enclosed by the integration path is normalized by the model cross-sectional area, A_o. The circulation value is normalized by the free stream speed and the model length. Several down stream locations, (different x/L's) are grouped together in the same plot to illustrate the estimated circulation for the model configuration tested. As expected, if a large enough area is used to cover all the vortex structure, the circulation value will reach a plateau value and that value can be used as the circulation for the model configuration. Also, this plateau value should be a constant for different x/L values for a developed vortical structure. However, there are cases where not enough vectors that can be adequately used to resolve the final anticipated circulation.

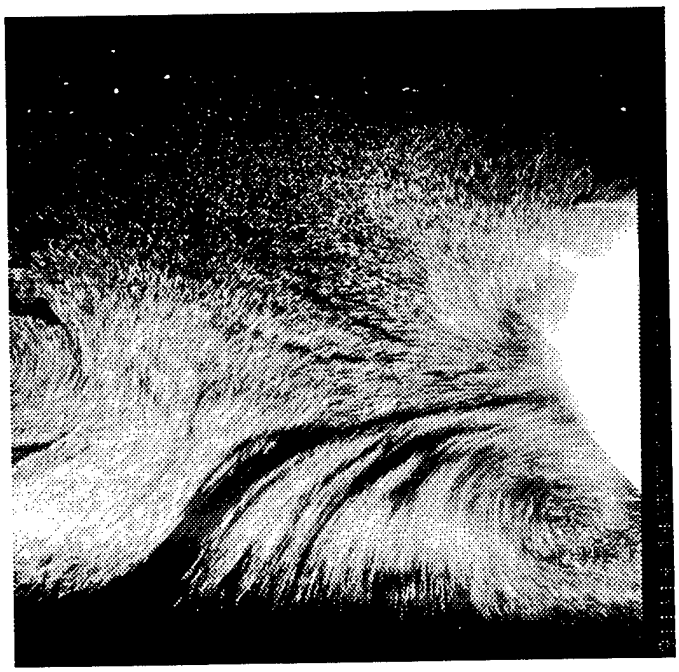
For a turning model, the local angle of attack for the sail varies from leading edge to trailing edge. Using the model geometrical dimension and actual model attachment distances to the carriage turning table, one can deduce this local angle of attack for all model configurations as shown in the



Yaw=16°, Pitch=-8°, Roll=0°



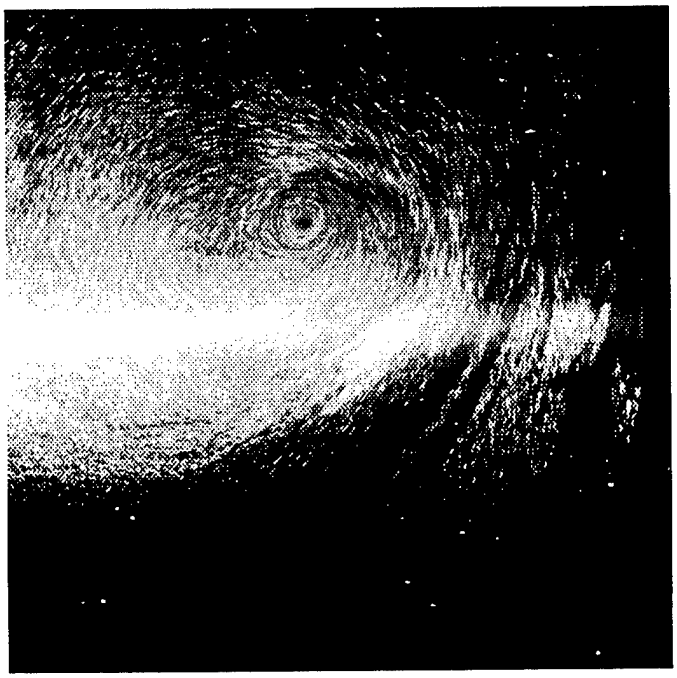
Yaw=16°, Pitch=-8°, Roll=-15°



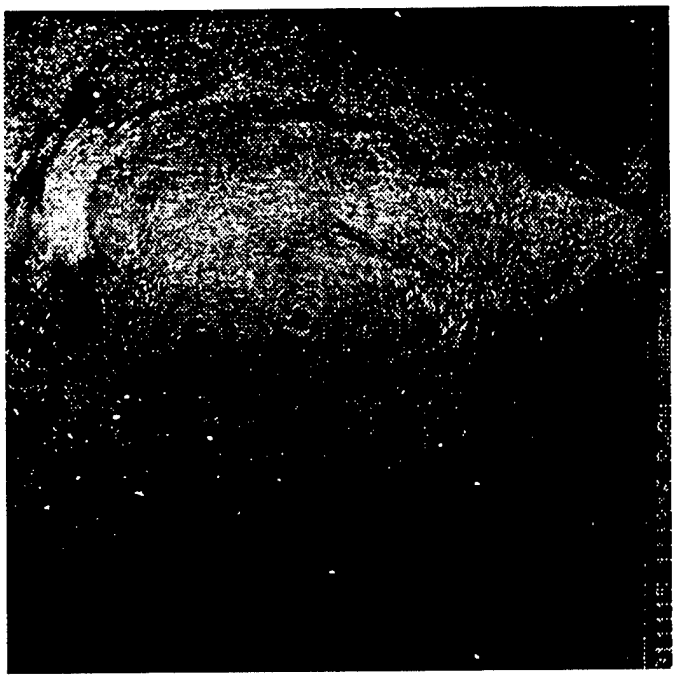
Fully Appended Model Configuration
Yaw=16°, Pitch=-8°, Roll=30°

(3a) x/L=0.75

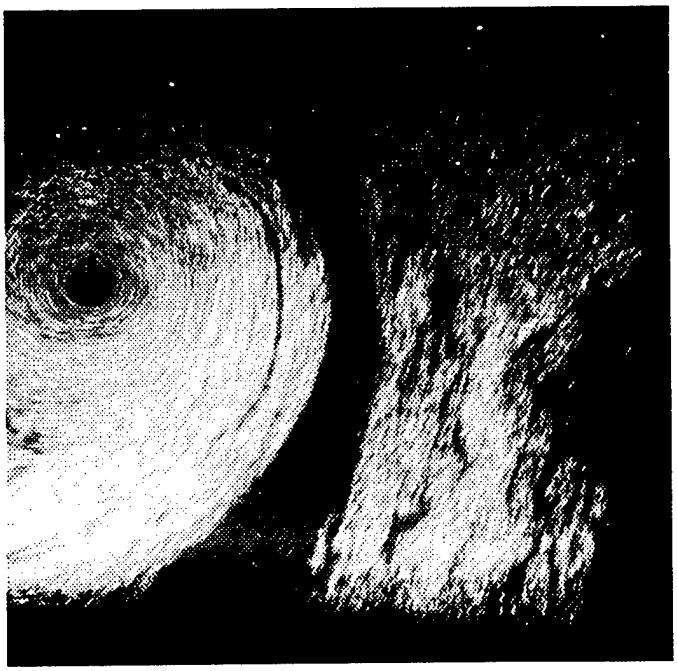
Figure 3 Typical flow image showing the effect of model roll angles on the sail vortex



Yaw=16°, Pitch=-8°, Roll=0°



Yaw=16°, Pitch=-8°, Roll=-15°



Fully Appended Model Configuration
Yaw=16°, Pitch=-8°, Roll=30°

(3b) x/L=1.25

Figure 3 (Continued)

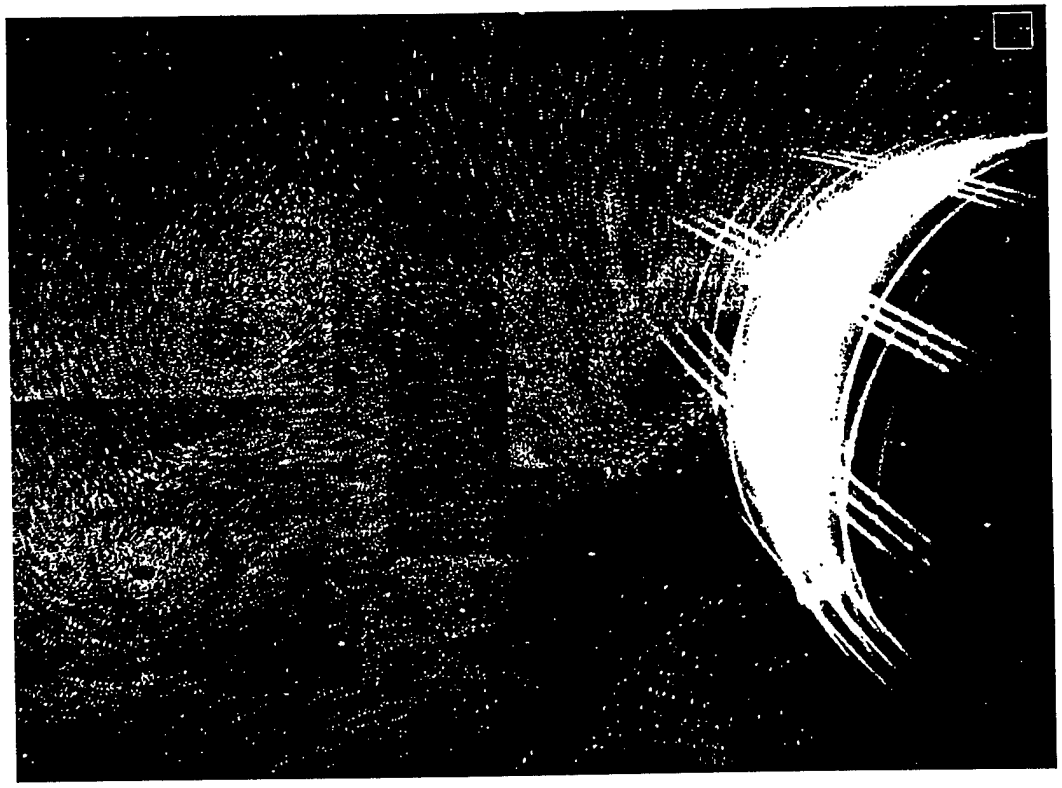


Figure 4 Example of a digitized image.

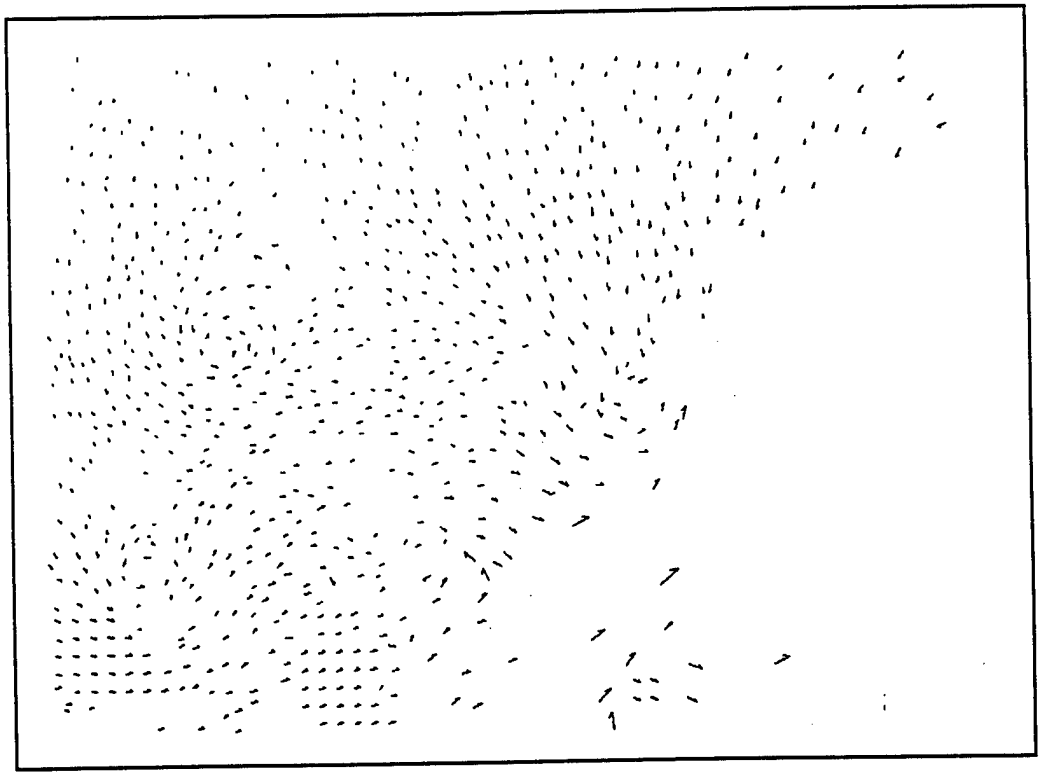


Figure 5 Example of a vector plot ot the image from Figure 4.

following table:

Local Angle of Attack on Sail During Turning

Yaw Angle	Pitch Angle	Leading Edge	Trailing Edge	1/4 Chord	Sail Vortex Rotational Direction
0	0	-6.887	-4.150	-4.833	CW
8	0	0.843	3.672	2.964	CCW
16	0	8.432	11.41	10.663	CCW
0	-8	-6.635	-3.937	-4.611	CW
8	-8	1.156	3.923	3.231	CCW
16	-8	8.819	11.708	10.963	CCW

From this table, one can estimate the theoretical circulation strength based on the airfoil theory; i.e., $\gamma = 0.5\ \alpha\ \pi\ AR$, where AR is the aspect ratio of the sail and α is the angle of attack.

The measured overall sail circulation is best fit to use the local angle of attack at 1/4 chord. From Fig. 6, the normalized sail circulation is 0.014 for yaw=16 deg and pitch=0 deg. This is equivalent to 289 in^2/sec. The theoretical prediction is 283 in^2/sec if the alpha used in the above table is 10.663 degrees. Also, it is seen in the local angle of attack calculation the effect of model pitch is only secondary, i.e., the estimated local angle of attack is about the same if the yaw angle is the same. This is reflected in Fig 6 that the two measurements are about the same for both pitch angles with the same model yaw angle setting. In fact, this was observed during the test that the strength of the sail vortex from these two model configurations is about the same. If one uses normalized circulation of 0.004 for the yaw=8 deg case in Fig. 6 and alpha=2.964 deg from the table, one can get $\Gamma_{meas.}$=82.5 in^2/sec versus $\Gamma_{theo.}$=78.7 in^2/sec. Similarly, for the yaw=0 deg case, the comparison is $\Gamma_{meas.}$=115.6 in^2/sec and $\Gamma_{theo.}$=128.4 in^2/sec (γ=0.0056 and alpha=-4.833 deg.). This comparison is not as favorable as in those larger yaw angle cases.

As to the vortex rotational direction, the measurement confirms the prediction by the theoretical argument in the above table. Due to the change of local flow angle of attack to the sail during the turn, the sail vortex is rotated clockwise as opposed to counter-clockwise rotation for yaw angles of 8 or 16 degrees.

A similar analysis procedure is applied to those fully appended model vectors. Their results are presented in Fig. 7. This set of data was collected at the beginning of the test program when the long timing pattern was set for flow visualization. By reducing these data for circulation calculation, one will suffer a much larger velocity uncertainty. This is because a rather longer timing, more than 10 milliseconds, is used to define the particle traces as compared to only up to 2 milliseconds for defining a particle dot in the image. There is no way to make sure that the entire particle traces are within the light sheets during their presence as the data point. Also, the fully appended model is equipped with sail and sailplanes. There is a strong interaction between these two vortical systems during the turn. Picture B-5 in Appendix B clearly demonstrates the difference between the sail vortices in these two configurations. The definition of the sail vortex is thus less clear in the fully appended arrangement. Nevertheless, similar circulation strength is observed as compared to the sail only configuration.

Circulation data are further collapsed for all x/L data in each test case and compared in Fig 8. The collapsed curves are the least squares fit of all available data for that particular test configuration. Except for the case of yaw=16 degrees and pitch=0 degree, the fully appended sail vortex always shows a higher strength. This could be because that during the line integration process a part of the sailplane vorticies is inevitably included into the sail vortex calculation causing

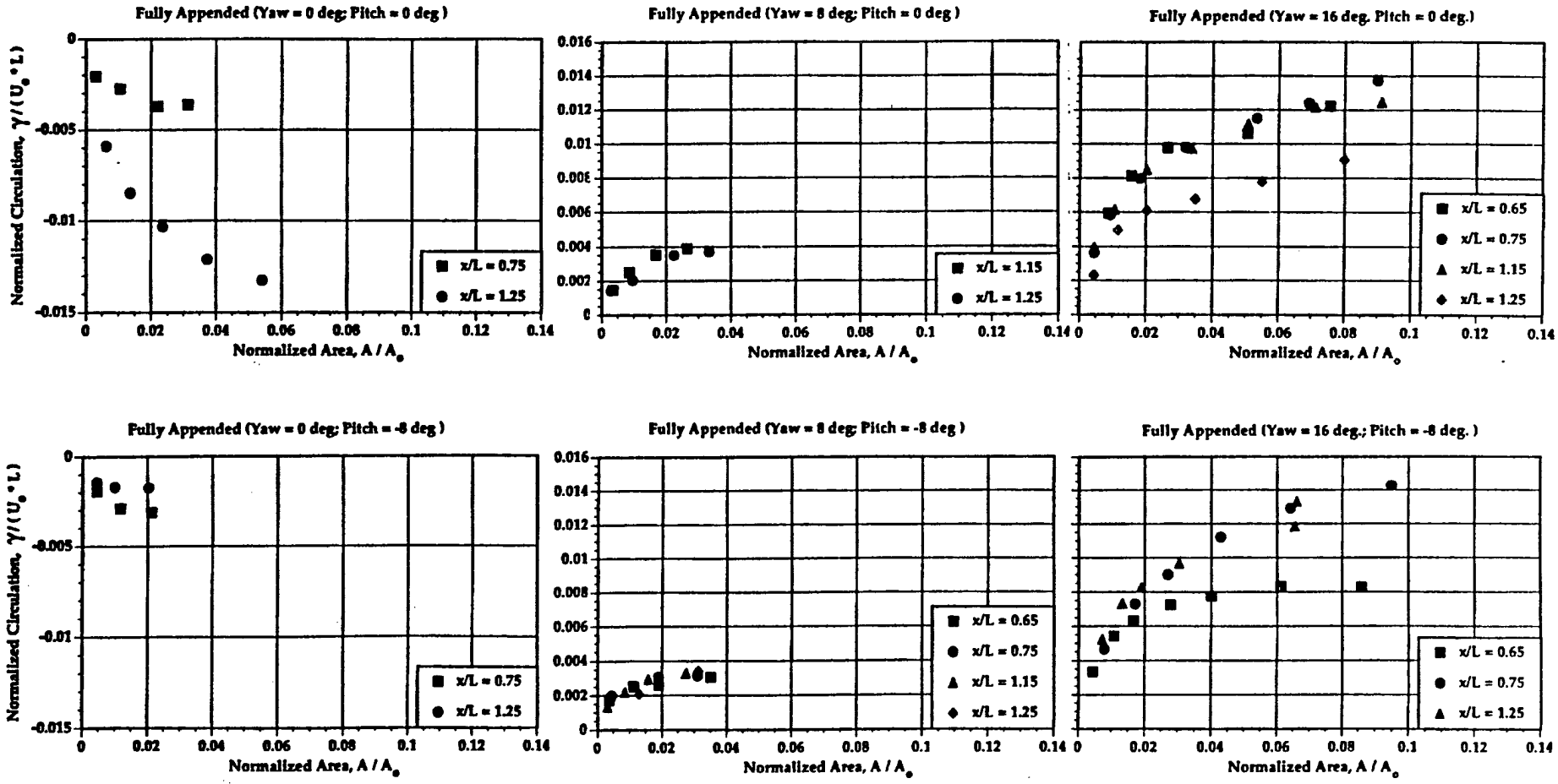


Figure 6 Sail circulation calculation from the Sail+Hull model configuration.

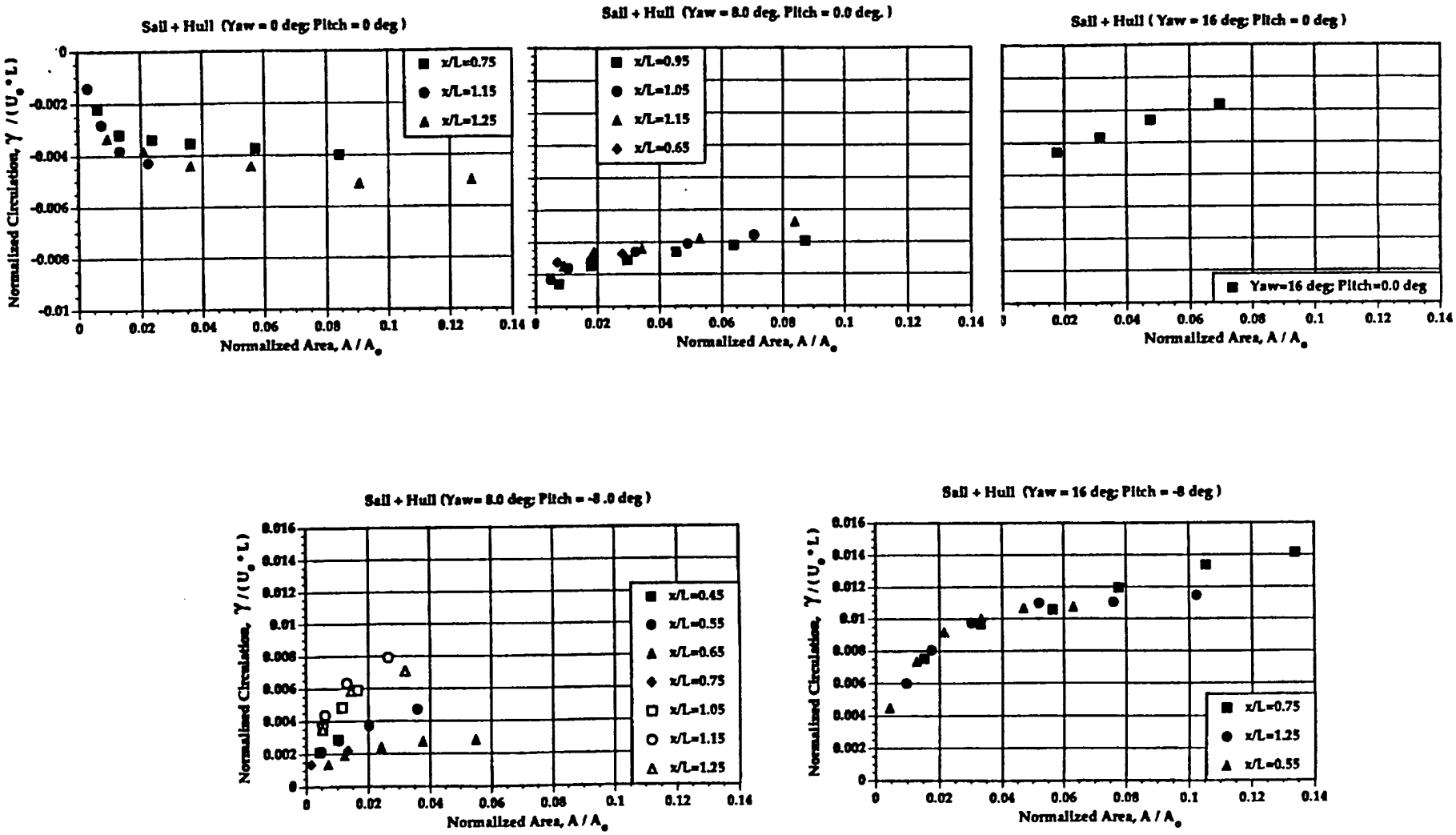


Figure 7 Sail circulation calculation from a Fully Appended model configuration.

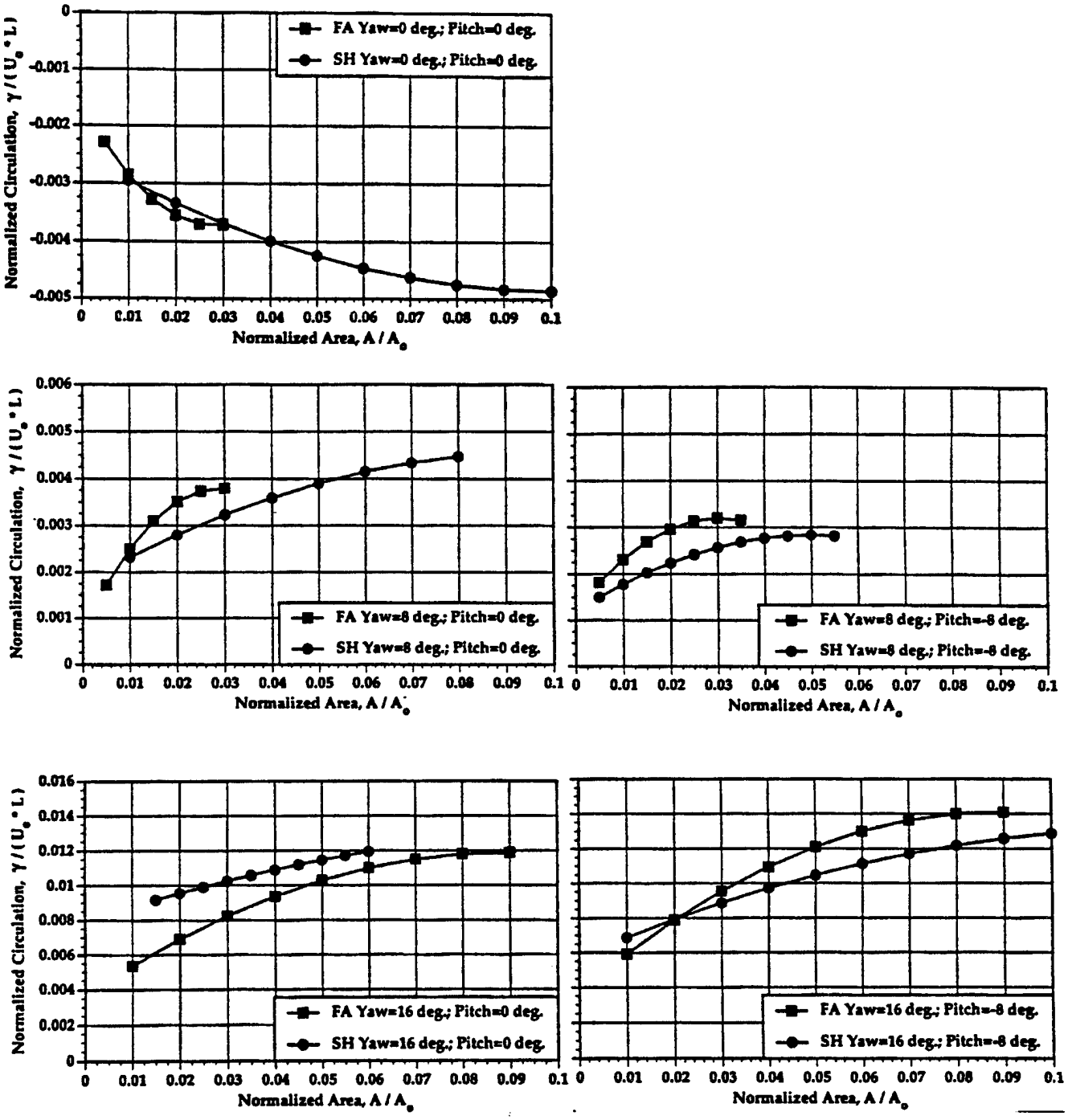


Figure 8 Curve-fitted representation of the sail circulation for the Sail+Hull model configuration and the Fully Appended model configuration.

an increase of vortex strength. The effect of model yaw angles on the circulation strength is shown in Fig 9 when the circulations are plotted together for each model configuration.

SAIL VORTEX MIGRATION

The definition of the coordinate system is illustrated in Fig. 10. The migration of the sail vortex centers for different model yaw/pitch angles are presented in Figs. 11 and 12 for sail+hull and fully appended case, respectively. As shown, the sail vortex center moves downward and swept away from the model. The effect of model yaw angle can be better presented in the lateral presentation of the sail vortex trajectory, Fig. 11. These vortices are literally displaced to a different location as compared to the zero yaw case. The amount of lateral displacement corresponds to the yaw angle for turning. The effect of pitch can be readily appreciated in the vertical plane data. For yaw=0 degree, the sail vortex moves very close along the body contour until the body begins to contract in the stern region. This flow pattern can be maintained if there is no pitch angle involved. Once the model is pitched, the vortex center will plunge downward. The addition of sailplanes for the fully appended case creates two more sailplane vortices which interact with the sail vortex. Typically, one of the sailplane vortices is immediately absorbed into the sail vortex system because its trajectory falls into the sails. The other sailplane vortex is seen to move around the sail vortex as a satellite initially. Eventually, it disappears into the dominant sail vortex structure downstream. The basic feature of the overall sail vortex trajectory is, however, about the same as that of the sail alone case.

HULL SEPARATION ANGLES

From the video images, the separated flow from the hull can be estimated. The table in Fig. 13 shows the separation angles. The definition of these angles is also presented in Fig. 13. For the bare hull case, the separation angles are about the same as that for an axisymmetrical body such as a spheroid. The flow is symmetrical around the body as can be seen from the separation angles from the upper and lower portions of the body. With the addition of the sail, the flow is no longer symmetric. When this is compounded with the pitch angle of the model turning, both the upper and the lower separation angles move up. These results are also plotted in Fig. 14 for comparison with the separation angles from a 6:1 spheroid for various angles of attack in linear tow. The separation angle is similar to those observed in the bare hull case.

FORCE COMPARISON

As a part of the PDV objective, the measured flow image is used to estimate the force/moment on the model which is compared to that obtained using on-board force gages. The formulation of the problem and the computation procedures are discussed in Reference 2. Briefly, the vorticity is calculated based on the measured velocity field and the lift and side forces are estimated as (Ref. 2, pp 129) :

$$C_{YL} = \frac{F_{yL}}{\frac{1}{2}\rho U^2 L^2} = \frac{-2}{UL^2}\int_0^{-\infty}\int_{-\infty}^{\infty} z\omega_x dy'\,dz \;;\; C_{YR} = \frac{F_{yR}}{\frac{1}{2}\rho U^2 L^2} = \frac{-2}{UL^2}\int_0^{\infty}\int_{-\infty}^{\infty} z\omega_x dy'\,dz$$

$$C_{ZL} = \frac{F_{zL}}{\frac{1}{2}\rho U^2 L^2} = \frac{2}{UL^2}\int_0^{-\infty}\int_{-\infty}^{\infty} y\omega_x dy'\,dz \;;\; C_{ZR} = \frac{F_{yR}}{\frac{1}{2}\rho U^2 L^2} = \frac{2}{UL^2}\int_0^{\infty}\int_{-\infty}^{\infty} y\omega_x dy'\,dz$$

where ω is the vorticity, subscripts L and R denote the left- and right sides of the force components with respect to the model centerline.

Using a 6:1 spheroid as a test case, images from the spheroid towed at 10-degree and 20-degree pitch angles are calculated for the lift forces generated by the model. They are plotted in Fig.

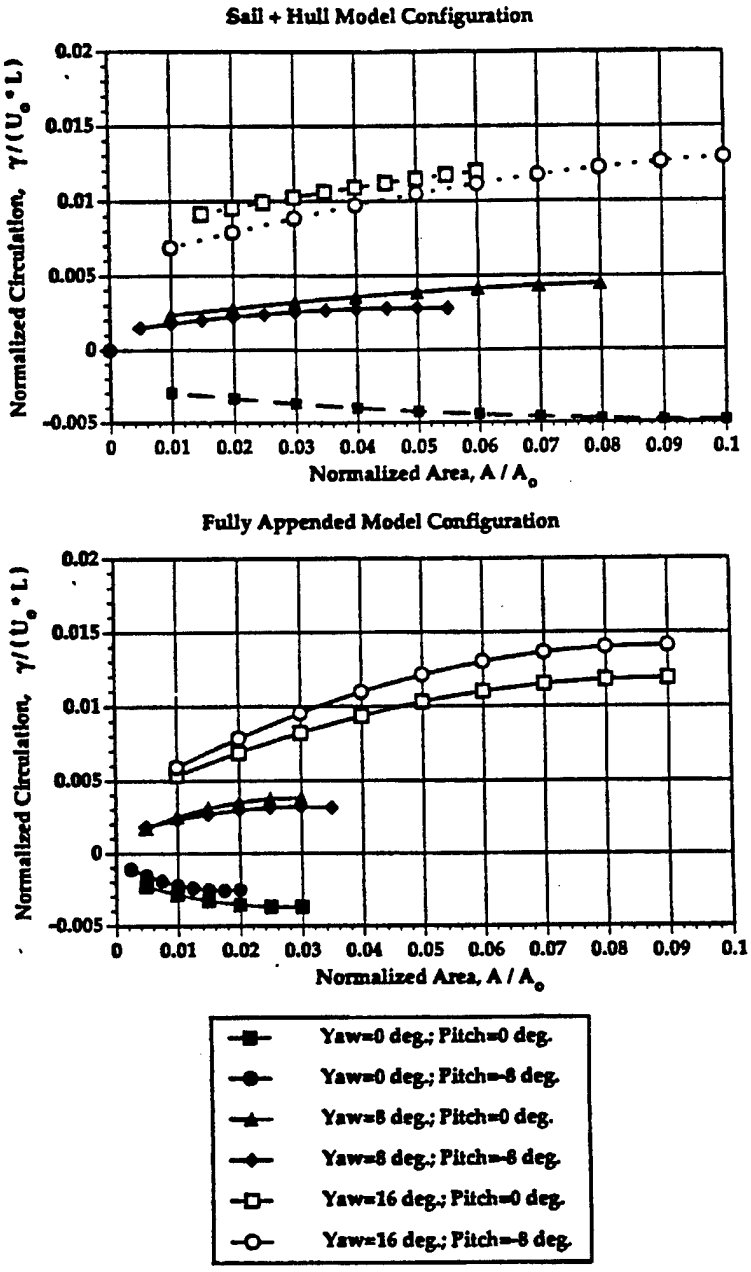


Figure 9 Summary comparison plot of the sail circulations.

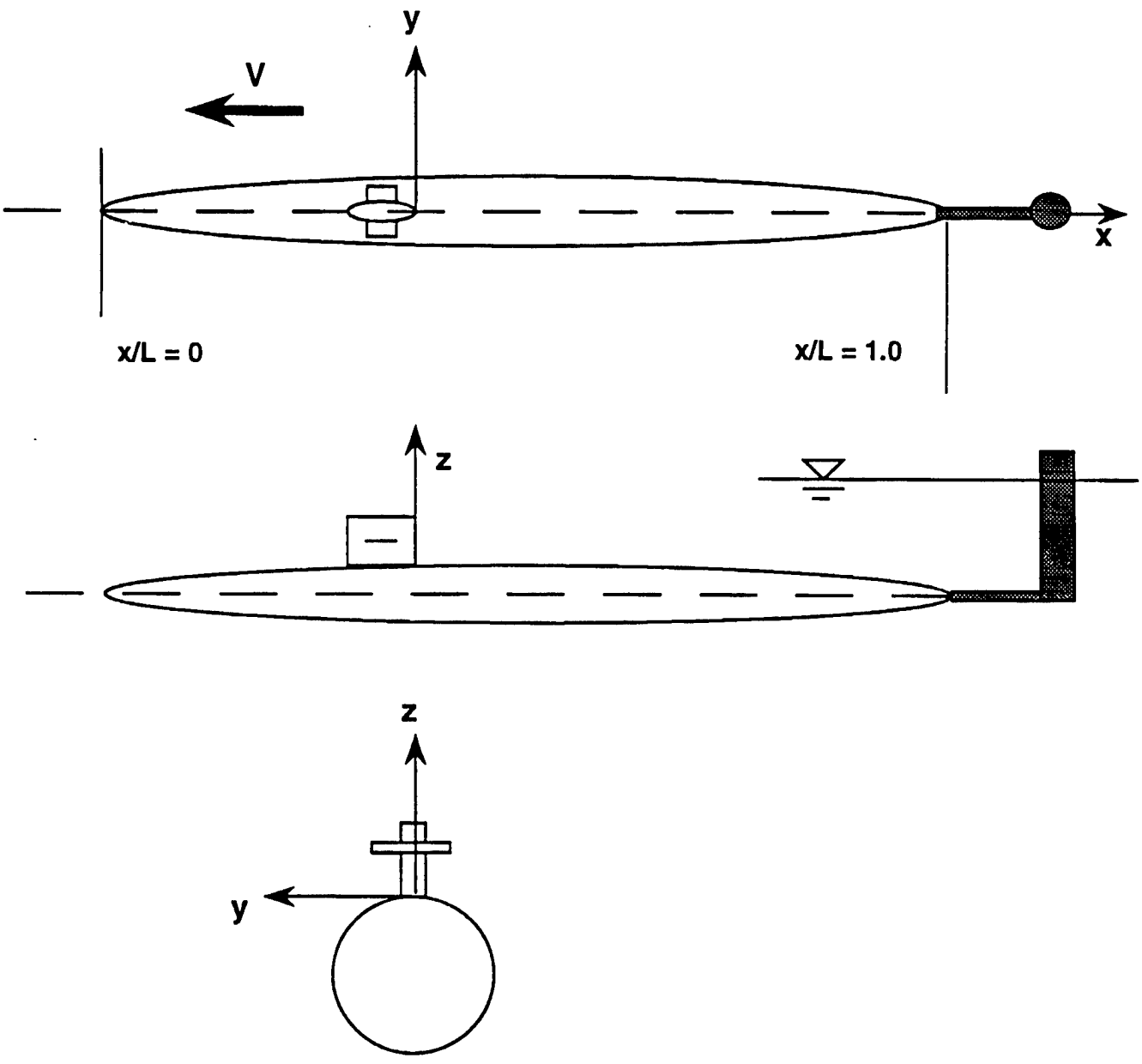


Figure 10 Model orientation for the sail tip vortex trajectory.

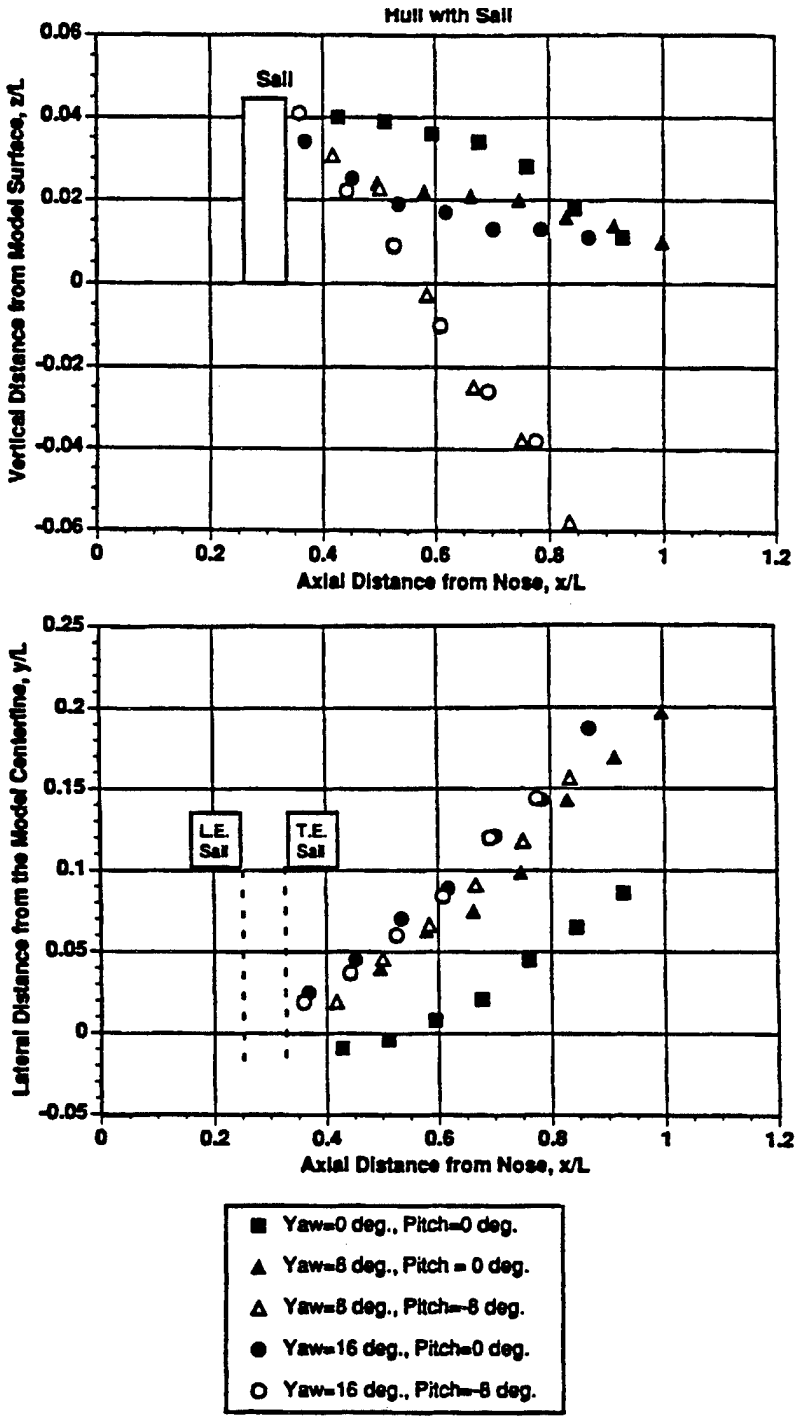


Figure 11 Sail vortex trajectory for the Sail+Hull model configuration.

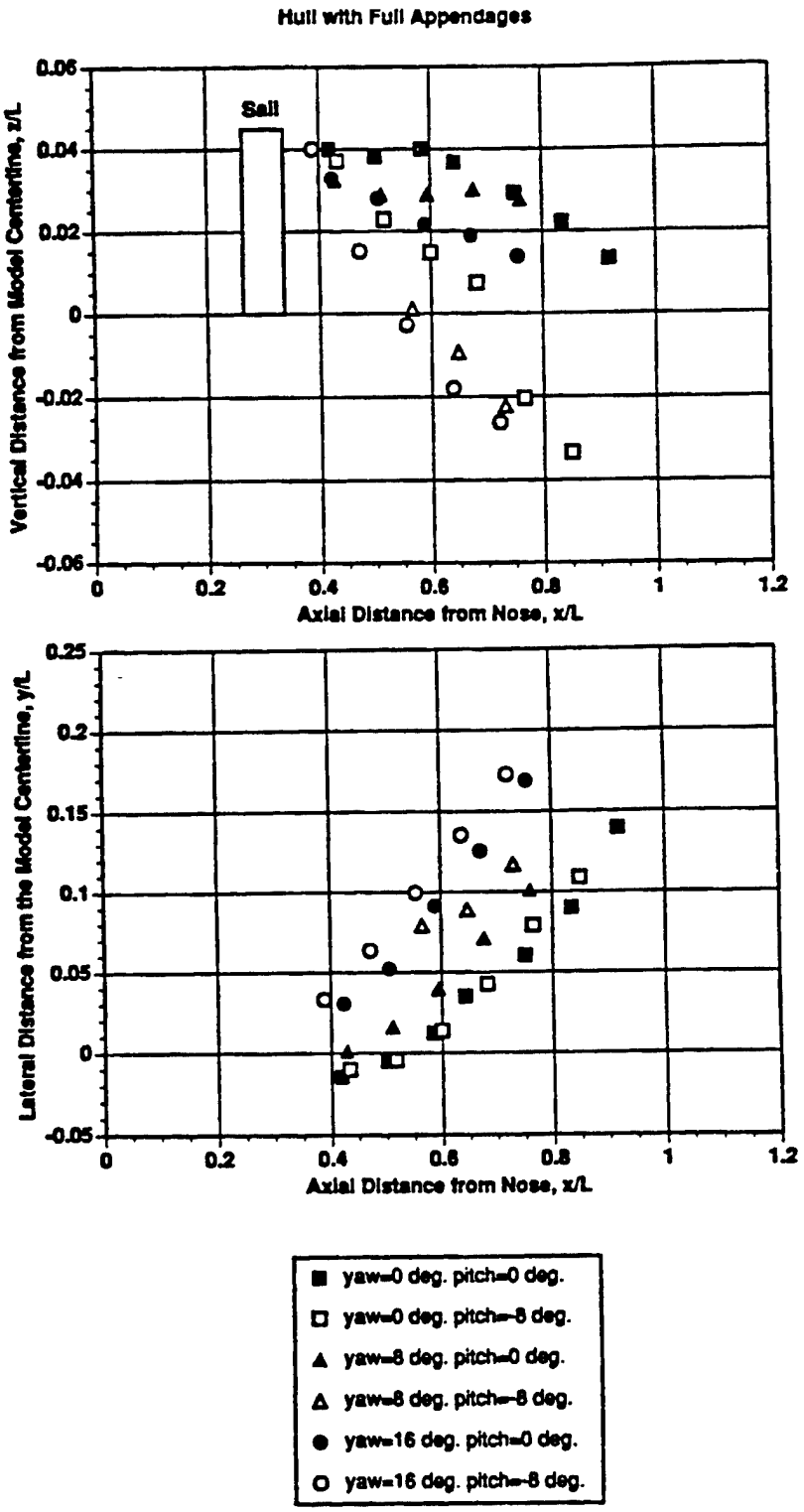
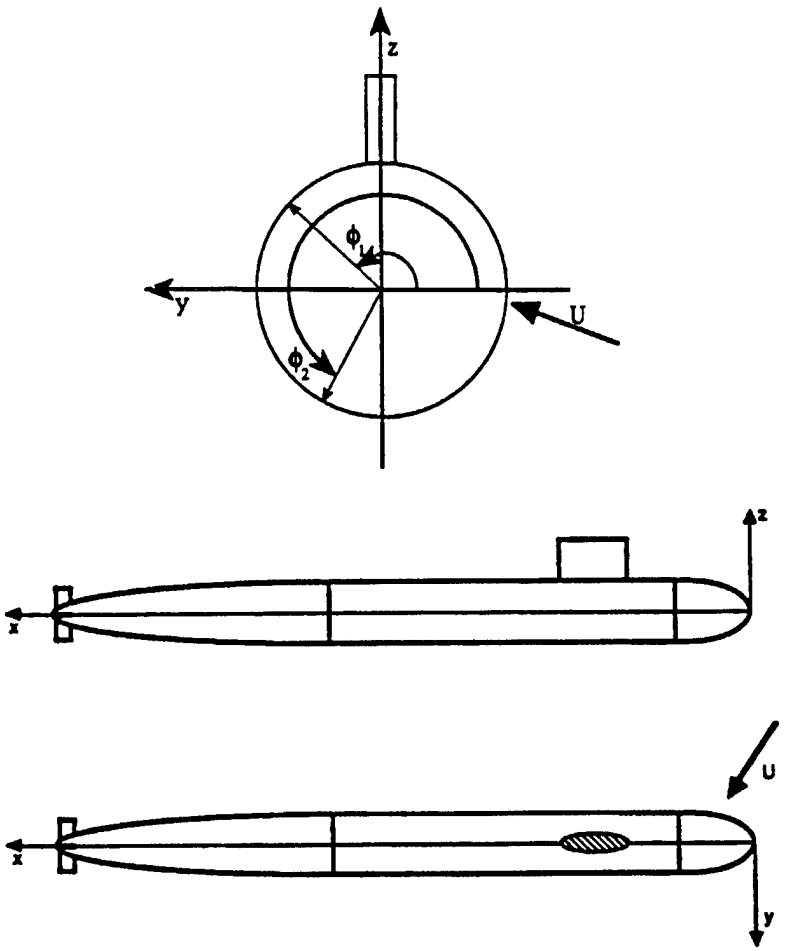


Figure 12 Sail vortex trajectory for the Fully Appended model configuration.



(13a) Model orientation for the hull vortex separation angle estimation.

Observed Separation Angles

Model Configuration	Yaw Angle	Pitch Angle	Roll Angle	$\phi_1°$	$\phi_2°$
Bare Hull	8	0	0	126	234
Sail + Hull				130	234
Fully Append				126	236
Bare Hull	8	-8	0	105	260
Sail + Hull				116	270
Fully Append				105	270
Bare Hull	16	0	0	100	250
Sail + Hull				-	255
Fully Append				99	240
Fully Append	16	0	15	90	270
Fully Append	16	-8	30	-	260

(13b) Hull separation angles from video images.

Figure 13 Hull vortex separation angles.

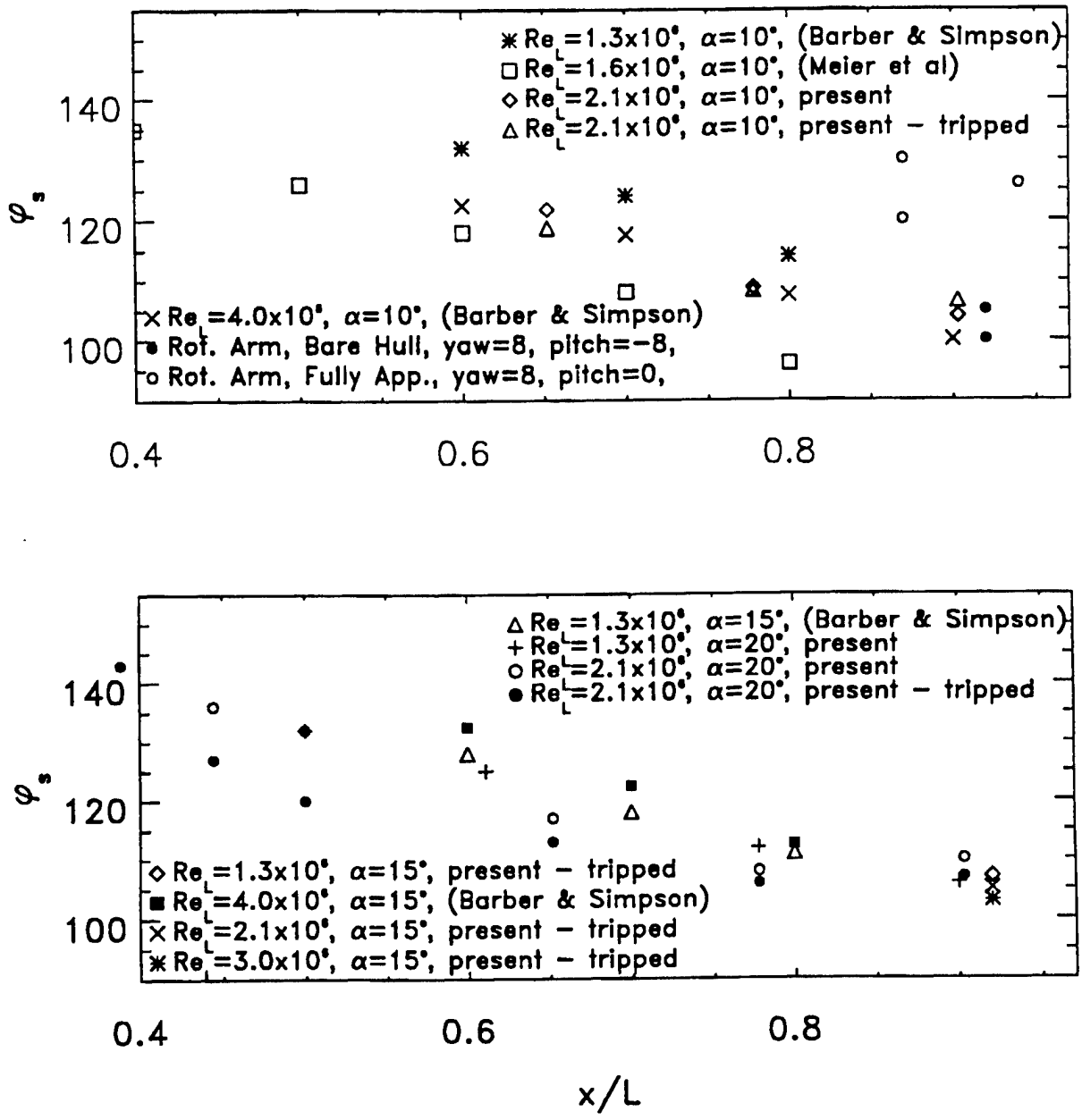


Figure 14 Comparison of the hull separation angles with the 6:1 spheroid data.

15 with the forces generated by the DARPA bare hull model tested in the Rotating Arm facility. It is understood that the two models do not have the same scale, the lift coefficients are normalized with their respective model lengths and speeds and the order of magnitude for these two tests should be similar. For this comparison, the effective model angle of attack, when both pitch and yaw angles are imposed, is calculated based on the model geometrical dimension presented as AOA in Fig. 15. The comparison is favorable based on the order of magnitude only. The differences can be attributed to the difference in Reynolds numbers and the modes of towing; the spheroid is towed in straight line while the DARPA model is towed in circular path even though the equivalent angle of attack is about the same. Angular velocity effect is not included in the straight line towing. This exercise proves the potential of PDV images for force estimation.

This force estimation technique for PDV images is then applied to the Rotating Arm flow images. Due to the difficulty of differentiating the vortical structures from the sail, sailplane, hull, and stern appendages, only the lift force from the sail is carried out in this section, although theoretically, the same procedure can be applied to all component of the vortical structures. Two calculated cases of sail lift and side forces are tabulated below.

File Name	Y	P	R	(From Images) 10^{-3} Lift force	Side force	x/L	(measurement) 10^{-3} Lift Force	Side Force
1211204	8	0	0	3.08	-2.70	0.65	0.363	-3.535
1211304	8	0	0	1.61	-1.84	0.55		
1209113	16	0	0	0.87	1.49	0.75	1.47	0.944
1209114	16	0	0	0.82	2.04	1.25		

In the table, the force measurements from the concurrent test condition are also listed. The comparison is not as good as expected. Two sources of this disagreement are conjectured:

(1) The PDV image is instantaneous but the force measurement is an integrated value. For a typical force measurement the integration time is about 20 seconds. The history of the response of two force gages for the lift force is shown in Fig. 16-a and -b respectively. The resultant instantaneous lift force is in Fig. 16-c. The excursion of the minimum and maximum force reading is from -96.39 kg (-212.06 lb) to 12.63 kg (27.79 lb) with mean at -32.14 kg (-70.71 lb) and standard deviation of 15.36 kg (33.80 lb) (refer to Table 3 for sample force calibration record). Similar variation of side forces is shown in Fig. 17 for reference. Even with these rather wide ranges of force variation, the repeatability of the force gage reading is good. A separate report on tow tank force measurement uncertainty is underway. A means of using to use PDV force estimation (as compared to the force gage measurement) needs further investigation.

(2) The flow we are measuring is unstable by nature. This may contribute to some of the fluctuation discussed in (1). With a given instrument setup and model arrangement, extensive repeated measurements have been made in a controlled environment in the 140-ft towing tank for the 6:1 spheroid. Figure 18 shows three consecutive runs for angle of attack of 20 degrees. The measurement is made at x/L=0.9 and a Reynolds number of 2.1×10^6. As demonstrated in the vector plots, the left and right vortices oscillated from run to run and within each run. Naturally, the vorticity maps are different. More importantly, because the vortex center changes its position, the resultant moment on the body varies dramatically, as shown in Fig. 19.

Based on forgoing discussion, one should be aware that if PDV is to be used to deduce the force/moment information, enough repeated runs are necessary to derive a clearer picture of what is happening. One image can not be used to tell the whole story.

UNCERTAINTY ANALYSIS

To estimate the velocity uncertainty from the PDV measurement, one needs to examine the

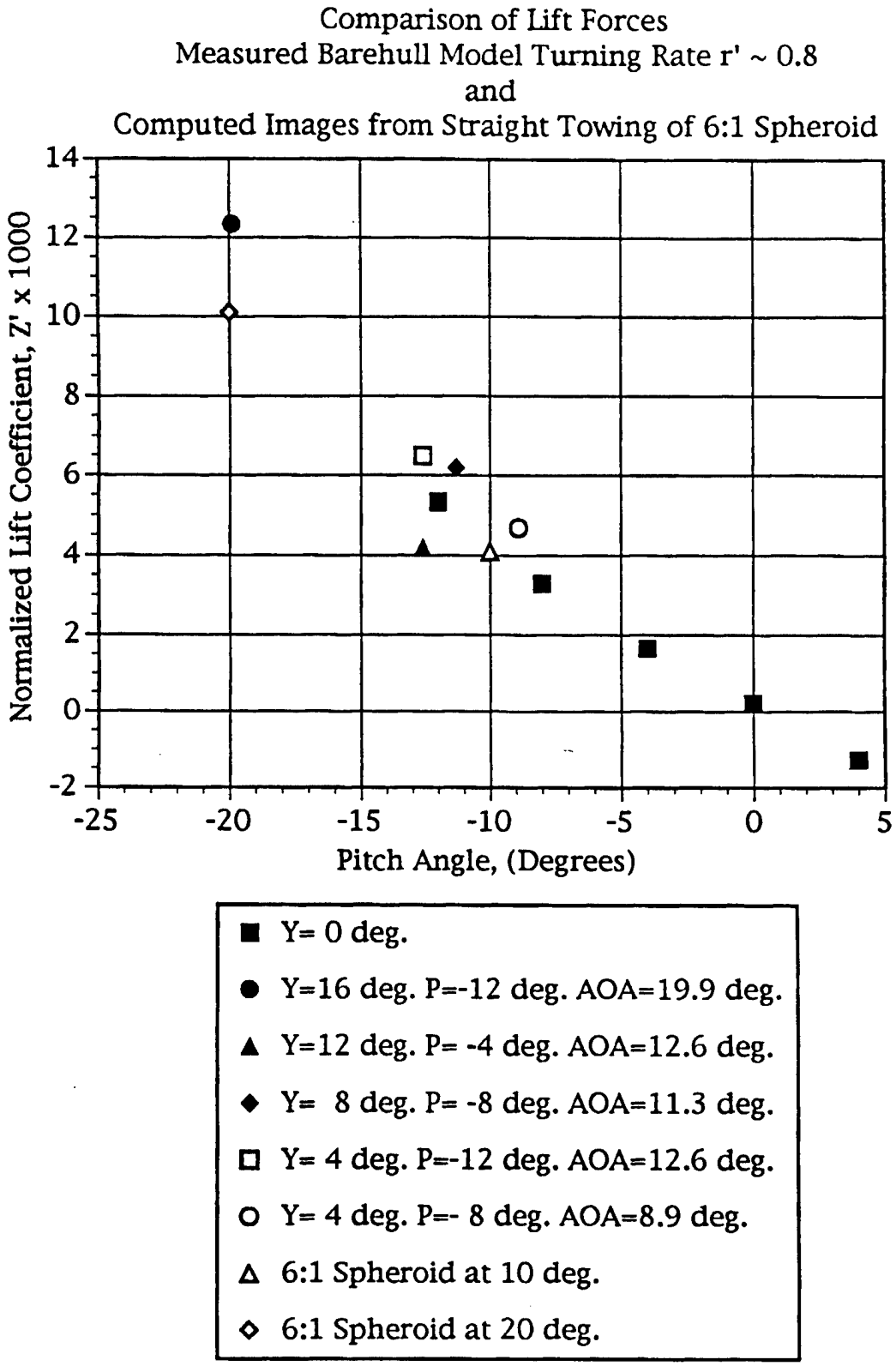
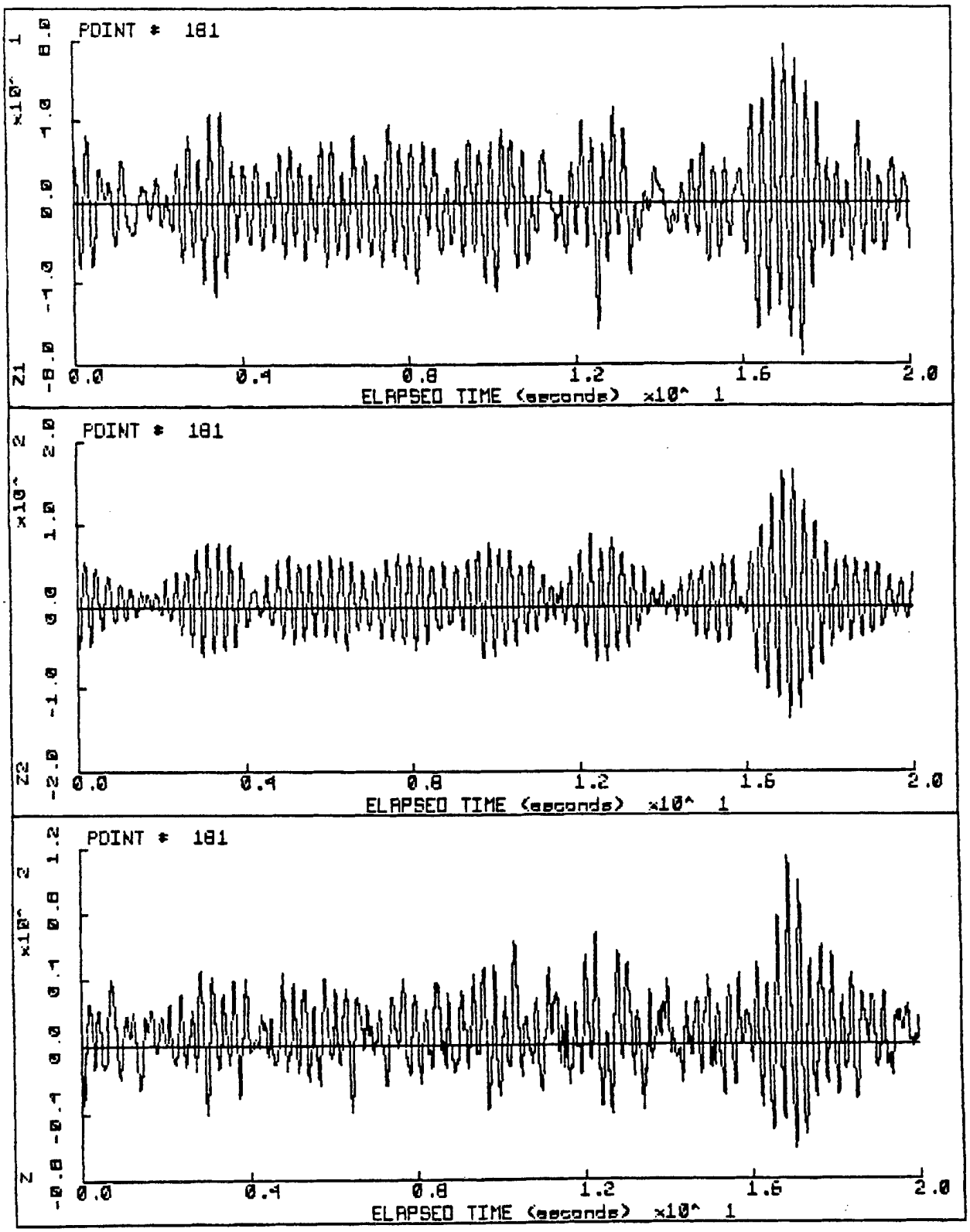


Figure 15 Comparison of lift forces measured for bare hull model turning rate r'~0.8 and computed images from straight towing of a 6:1 spheroid.



Lift Force (+ Downward)

Figure 16 Lift force calibration record.

Table 3 Data collected and reduced at 60 samples/second.

FILE RD1:PT0181.DAT

RUN TITLE: PITCH VARIATION
TEST TITLE: DARA CALIBRATION - GOOD FOR STING PHASE II AND SAILPLANE / BOWPLANE TEST
SUBTITLE: OUT OF DRYDOCK
POST-RUN COMMENT: PSI=0 TH=0 RL=-.7 R'=.2 1ST RUN

COLLECTION DATE: 10-MAR-92 COMEX: 08:05:11 FINEX: 08:05:31

ANALYSIS DATE: 12-FEB-93 TIME: 09:36:27

ROTATING ARM STING - HORIZONTAL PLANE

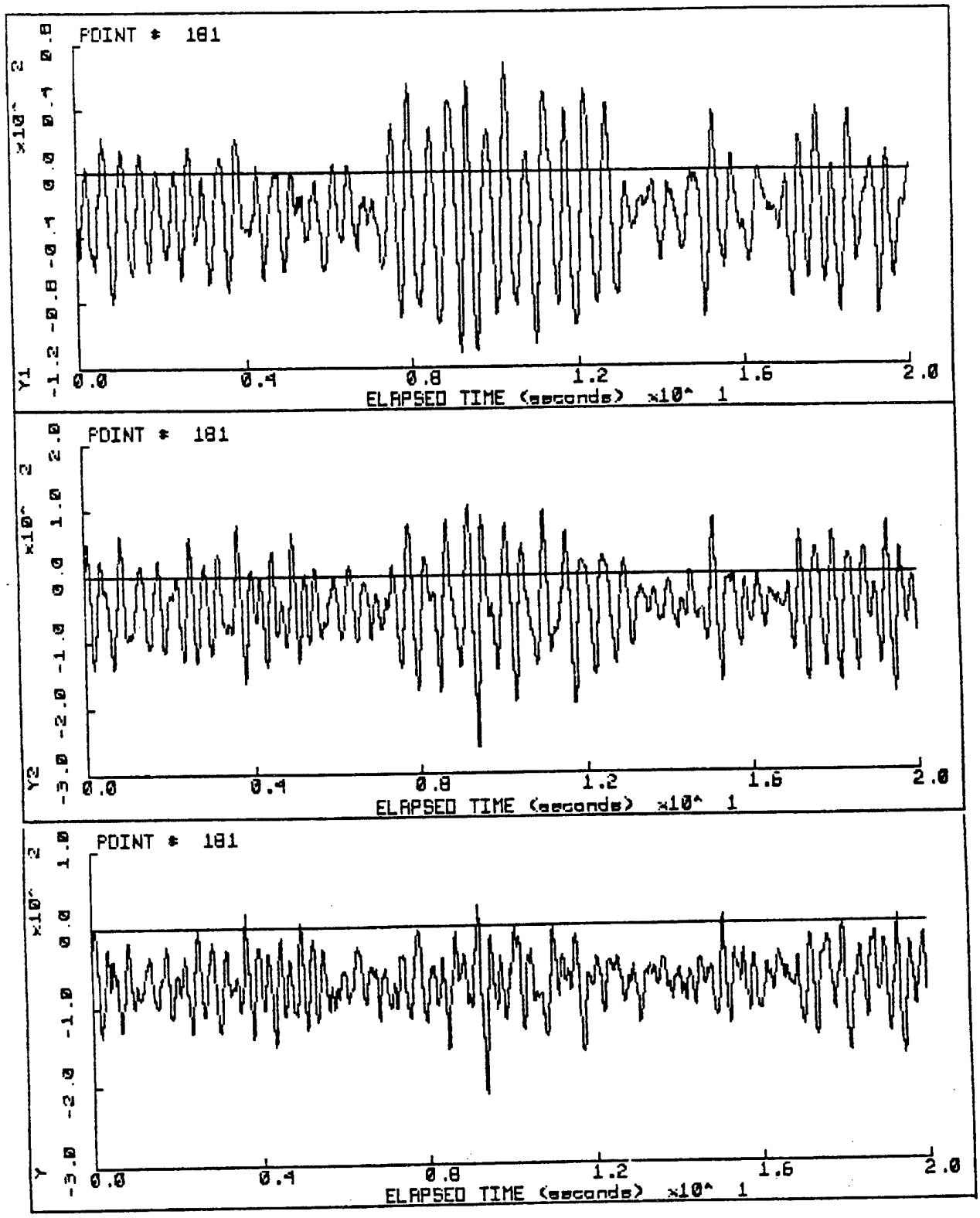
PSI = 0.00 DEG THETA = 0.00 DEG BRIDGE FAIRWATER ANGLE = 0.00 DEG RUDDER ANGLE =-17.00 DEG

YAW TABLE RADIUS = 84.040 FT MODEL RADIUS = 83.748 FT YAW TABLE PSI = 4.78

MODEL LENGTH = 17.000 1/2 GAGE SPACING = 3.000

1201. SCANS OF DATA

CHANNEL	ID	EU's	MIN	MAX	MEAN	RMS	STANDARD DEV
1	X1	pounds	-5.0124E+01	7.3577E+00	-1.8422E+01	2.0774E+01	9.6018E+00
2	X2	pounds	-1.5829E+01	2.6935E+01	9.4341E-01	7.3961E+00	7.3357E+00
3	Y1	pounds	-1.1137E+02	6.7954E+01	-2.5619E+01	4.1487E+01	3.2631E+01
4	Y2	pounds	-2.6042E+02	1.0682E+02	-4.5095E+01	7.3438E+01	5.7962E+01
5	Z1	pounds	-7.5926E+01	7.7800E+01	-9.0947E-01	2.1665E+01	2.1646E+01
6	Z2	pounds	-1.3585E+02	1.6547E+02	9.1206E+00	3.9922E+01	3.9088E+01
7	K1	foot-pounds	-1.5094E+01	6.3060E+00	-5.2826E+00	6.1066E+00	3.0634E+00
8	K2	foot-pounds	-1.5160E+01	6.2396E+00	-5.3429E+00	6.1567E+00	3.0590E+00
9	ROLL ANGLE	degrees	-8.1767E-01	-5.7718E-01	-7.0766E-01	7.0914E-01	4.5903E-02
10	OMEGA	volts	1.1060E-01	1.1304E-01	1.1185E-01	1.1185E-01	4.3680E-04
11	AC-THETA (BAD)	degrees	-3.7373E-02	3.7373E-02	-1.1700E-02	1.6373E-02	1.1453E-02
12	AC-PHI	volts	-6.3348E-02	6.8267E-04	-3.0595E-02	3.1629E-02	8.0212E-03
13	PADDLE WHEEL	knots	4.8987E+00	4.9950E+00	4.9377E+00	4.9378E+00	1.6479E-02
14	MODEL SURGE ACC	volts	-2.6717E-02	2.7527E-02	-2.4283E-03	9.7702E-03	9.4636E-03
15	MODEL SWAY ACCEL	volts	-3.2972E-02	1.3779E-02	-9.9016E-03	1.2840E-02	8.1746E-03
16	MODEL VERT ACCEL	volts	-1.0094E-02	2.9768E-02	6.3651E-03	9.1978E-03	6.6397E-03
17	PAD SURGE ACCEL	volts	-2.6968E-02	6.6914E-03	-9.1405E-03	1.0127E-02	4.3588E-03
18	PAD SWAY ACCEL	volts	-9.4844E-02	1.8241E-01	2.9776E-02	4.0164E-02	2.6955E-02
19	PAD VERT ACCEL	volts	-5.4769E-02	6.0360E-02	4.6526E-04	1.8229E-02	1.8223E-02
20	X	pounds	-5.2404E+01	1.5682E+01	-1.7479E+01	2.1461E+01	1.2452E+01
21	Y	pounds	-2.1206E+02	2.7790E+01	-7.0714E+01	7.8379E+01	3.3804E+01
22	Z	pounds	-6.1477E+01	1.1335E+02	7.2111E+00	2.3147E+01	2.1995E+01
23	K	foot-pounds	-1.5127E+01	6.2728E+00	-5.3128E+00	6.1313E+00	3.0606E+00
24	N	foot-pounds	-6.1443E+02	9.4691E+02	5.8428E+01	2.6976E+02	2.6335E+02
25	M	foot-pounds	-6.4096E+02	6.9680E+02	2.7090E+01	1.7976E+02	1.7771E+02
26	Vk	knots	5.4879E+00	5.6090E+00	5.5497E+00	5.5497E+00	2.1674E-02



Side Force (+ Starboard)

Figure 17 Side force calibration record.

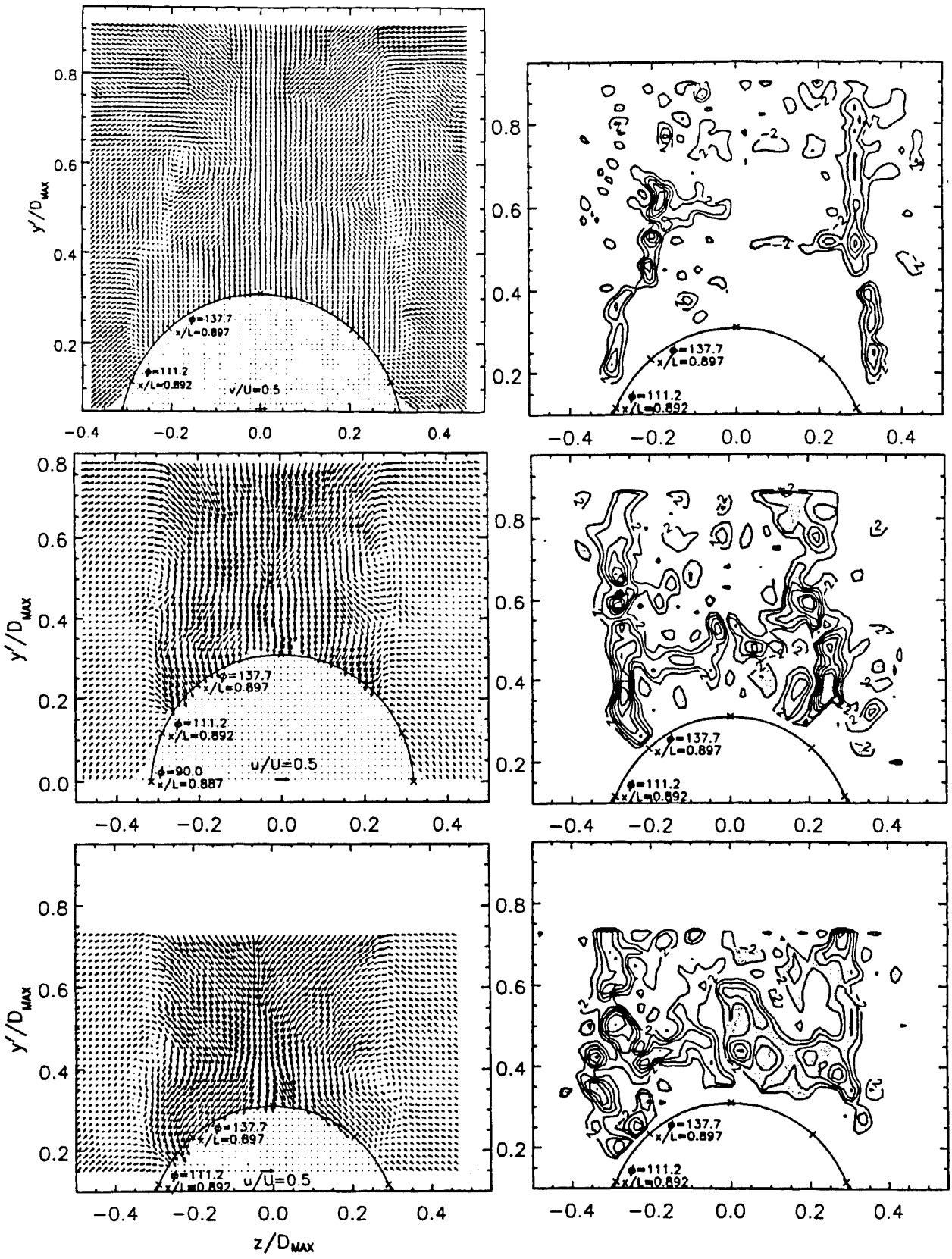


Figure 18 Unsteady flow for 6:1 spheroid measured at x/L=0.9 and angle of attack of 20 degrees, R=2.1 x 10^6.

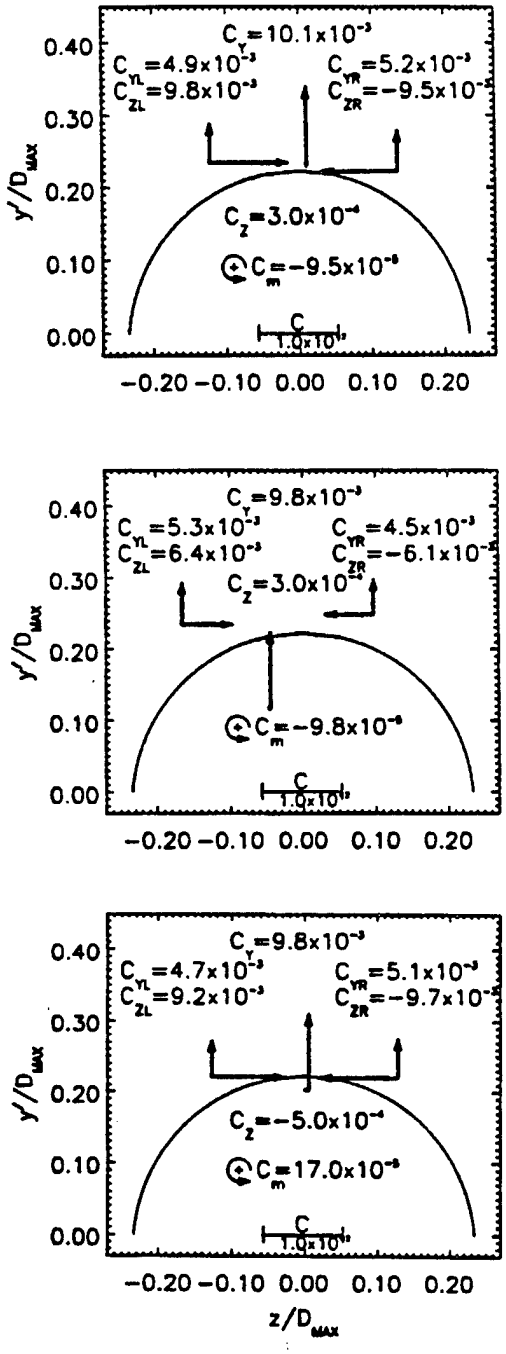


Figure 19 Force/moment computations for PDV images in Figure 18.

basic procedures involved in the selection of the laser pulsing time and the calibration procedure. In the following sections, a brief description of the selection criteria and the calibration procedure are introduced first. The estimated PDV measurement uncertainty is then presented.

SELECTION CRITERIA FOR THE LASER PULSE DURATION

Laser light sheets will be pulsed at a predetermined frequency for any PDV measurement. To estimate the minimum time required for the pulse, a hypothetical case is used for the table presented below. It is assumed that a 70-mm film with resolution of 100 lines/mm will be used and the required field of view is 3 ft x 3 ft. It is also assumed that there should be at least 5 lines to define the displacement of a particle during the pulse. Two laser light sheet thicknesses are used for comparison: 6.35 mm (1/4-inches) and the 12.7 mm (1/2-inches). The probability of detection D is defined as

$$D=(1-t_p/t_r)x100$$

where t_r is the residence time of the particle in the laser sheet which can be determined by $t_r=l_w/u$. Here l_w is the width of the laser sheet and u is the local fluid velocity perpendicular to the light sheet. The ship speed U is assumed to be 3048 mm/sec (10 ft/sec). The local velocity u is nearly equal to U on the body and decreases to 0.5U inside the middle of the boundary layer. Away from the body the value of u will rapidly continue to decrease. Table 4 shows the high detectability and good resolution of v that can be obtained away from the body. For instance, for the case when the flow field of interest is very near the body and a thick laser light sheet, 12.7 mm (1/2-inches) is used, it is necessary to have the film resolution to be larger than 100 lines/mm in order to increase the cross-flow velocity resolution of the particle motion to the resolution of 5% of U.

PDV CALIBRATION PROCEDURE

To begin the PDV analysis, it is necessary to establish the calibration for the particle images. This involves the determination of particle concentration, camera lens selection, film type (for defining the film resolution) and the magnification factor used in the image processing and digitization (for defining the imaging resolution). A procedure was developed in the 140-ft tank and is summarized below.

The first part of the calibration involves the selection of camera lens setting, light sheet dimension and laser pulse rates to get the film resolution required for 'clear and sharp' flow field pictures. An aquarium containing the dispersed particle/water mixture is lowered into the towing tank. The particle concentration is similar to the one to be used in the actual model tests. These particles are suspended in the aquarium and remain stationary. A laser light sheet is positioned to illuminate a section of the aquarium which is parallel to the direction of carriage motion. The thickness of the light sheet is selected as 6.35 mm (1/4-inch). An underwater camera is then installed on the carriage facing the light sheet to be towed by the carriage at a prescribed speed corresponding to the cross-velocity of interest. The laser pulsing rate is selected to match this cross speed. Various camera lens settings and types of film speeds (providing different film resolutions) are then evaluated. The output from this calibration process is the best film resolution corresponding to the optical/recording arrangement.

The second part of the calibration involves the uncertainty analysis of the particle images recorded on the film negatives, i.e., what images the film captured that are analyzable and the error introduced in defining the length scale of the particle traces. With a given laser pulsing rate, the particle velocity can thus be easily calculated. The particle images are analyzed with the image processing software. To begin this part of the calibration process, the image resolution is selected to magnify a portion of the flow on the negative. The criterion to choose this resolution depends on

the range of the anticipated particle speeds presented. The upper limit of the image magnification is what the film can record - the film resolution. It is usual to select the image resolution about 20% of the film resolution. If the film resolution is about 100 lines/mm, as used in generating Table 4, the image resolution can be 20 lines/mm, or 20 pixels/mm.

The digitized light intensity contour traces of two typical particles are presented in Fig. 20. Figure 20 also shows the light intensity of a typical particle plotted along its long axis, the direction of motion. The sharp slope of this profile plot is used to define when the film begins to recognize the illuminated particle and it is used by the computer as the particle detection criteria. The particle displacement length scale can thus be established with known laser pulsing rate.

The analysis of the probability density function of the estimated displacement for a speed of 0.51 ft/sec indicates that the mean displacement of all particles surveyed on the digitized film negative is about 103 pixels. The standard deviation of the computer determined displacement is 2.71 pixels. Two standard deviations, which shows 95% confidence in the data, would yield about 5 pixels. Additional tests are conducted for other speeds. Since the two standard deviation uncertainty of the particle displacement is about 5 pixels for the range of velocities used in this calibration, the digital image processing can actually resolve a particle displacement of 5 lines or 5 pixels due to the cross flow.

PDV MEASUREMENT UNCERTAINTY

For the present image magnification, 20 pixels/mm, each pixel has a length scale equal to 0.045 mm (0.0018 inch). Thus 2.71 pixels is translated into a physical dimension of 0.12 mm (0.005 inch), giving an error of $\pm 2.5\%$ of the measured velocity. Higher image resolution can be used but it does not improve the error uncertainty unless higher film resolution is achieved.

CONCLUSIONS AND RECOMMENDATIONS

The PDV technology is successfully extended to a large towing tank facility, the DTMB Rotating Arm facility. The feasibility of using PDV for analyzing various model configurations is well demonstrated, both in the hardware arrangement and software analysis. Valuable lessons are learned as how to physically arrange the necessary hardware, such as camera positions, laser light sheets and most of all seeding requirements. There is always a trade off between what is required for the image resolution and what is desired to capture on film. The resolution of PDV images can be improved dramatically if the area of interest is limited. A detailed flow can be recognized with higher magnification factor. For a global behavior of the complete flow, the image resolution suffers in some of the regions because different flow time scales are involved. With recent advances in fiber optics, there is a greater possibility to arrange multiple cameras controlled by their respective fiber optics for light source and timing requirements. If the image resolution can be relaxed somewhat, a digital camera can then be used effectively which can also eliminate the film developing step in the image capturing and digitizing processes. The image data analysis programs used in the present report are greatly improved from their earlier time consuming days with less than one hour turn around for each analyzed image. Improvements are still needed in the streamlining the data flow and presentation. PDV can then truly be regarded as one of the diagnostic tools, for complicated flow.

With PDV data gathered under this program, an attempt was made to put together some preliminary flow parameters for various model configurations. They can be used as a reference for the configuration of interest. Since there are very few repeated measurements, these data should be used with caution. They are only instantaneous snap shots of a complex and unsteady flow. With the demonstrated techniques, it is recommended that another series of the Rotating Arm tests be conducted to gather more controlled data sets to establish a data bank of information to help the CFD community.

Table 4 The minimum velocity resolvable in the plane of a laser light sheet
U=3048 mm/sec (10 fps)

u mm/sec	t_r (sec) l=6.35 mm	l=12.7 mm	mm/sec (%)	D = 50% t_r/t_p=2 l=6.35 mm	l=12.7 mm	D = 67% t_r/t_p=3 l=6.35 mm	l=12.7 mm	D = 80% t_r/t_p=5 l=6.35 mm	l=12.7 mm
3048	0.00208	0.00417	v	628.45	313.47	942.68	471.34	1571.1	785.57
u/U=1.0			(v/U)	(21%)	(10%)	(31%)	(15%)	(52%)	(26%)
1524	0.00417	0.00834	v	314.23	156.73	471.34	235.67	785.07	932.53
u/U=0.5			(v/U)	(10%)	(5%)	(15%)	(7.7%)	(26%)	(13%)
609.6	0.01042	0.02084	v	125.45	62.73	188.17	94.09	313.62	156.81
u/U=0.2			(v/U)	(4%)	(2%)	(6%)	(3%)	(10%)	(5%)
304.8	0.02083	0.04166	v	62.75	31.38	94.13	47.07	156.89	78.44
u/U=0.1			(v/U)	(2%)	(1%)	(3%)	(1.5%)	(5%)	(2.5)
152.4	0.04167	0.08333	v	31.37	15.68	47.07	23.53	78.44	39.22
u/U=0.05			(v/U)	(1%)	(0.5%)	(1.5%)	(0.77%)	(2.5%)	(1.3%)

Note: Other parameters used in the computation include

1. Film resolution is 100 lines/mm
2. 70 mm negative film is used
3. Pixel resolution is 1 pixel=0.075 mm (from Rotating Arm Tests)
4. Camera *f*-stop is 3.5

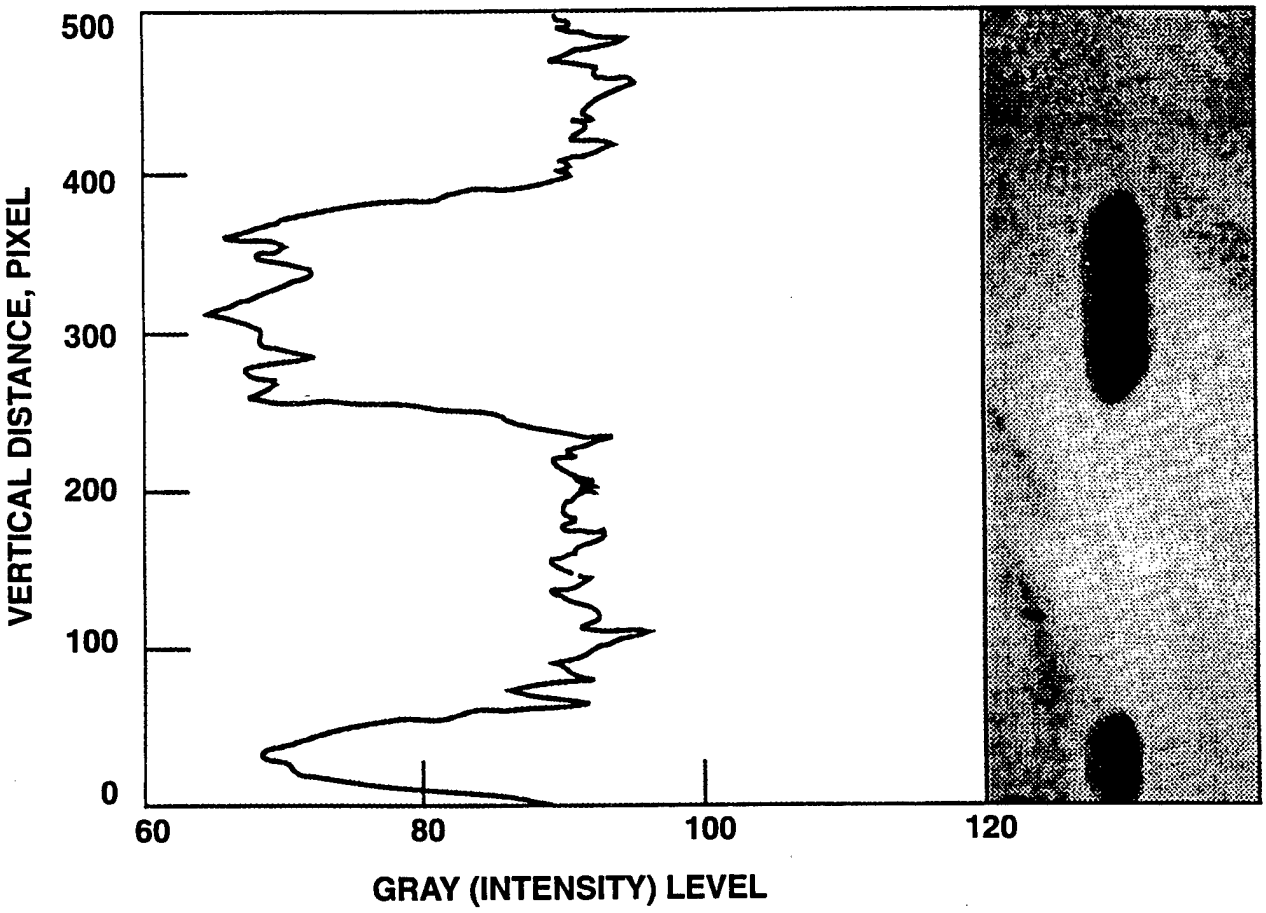


Figure 20 The image intensity distribution along a vertical line of a particle trace pair.

ACKNOWLEDGEMENTS

The authors are grateful to Mr. Gary Jones of DARPA for his continuous interest in developing the PDV technology and providing funding for the test and to Dr. T. T. Huang, the PDV program manager, for his guidance in all phases of the experiments and data analyses. Consultation with Dr. Ming Chang and Dr. Jerome Feldman are also appreciated.

APPENDIX A

Plan View Representation of the Relationship of Model Orientation with Respect to Basin and Instrumentation Platform.

Figure A1 Yaw=0 deg.; Pitch=0 deg.; r'=L/r=0.6555

Figure A2 Yaw=0 deg.; Pitch=-8 deg.; r'=L/r=0.6400

Figure A3 Yaw=8 deg.; Pitch=0 deg.; r'=L/r=0.68060

Figure A4 Yaw=8 deg.; Pitch=-8 deg.; r'=L/r=0.6588

Figure A5 Yaw=16 deg.; Pitch=0 deg.; r'=L/r=0.7061

Figure A6 Yaw=16 deg.; Pitch=-8 deg.; r'=L/r=0.6777

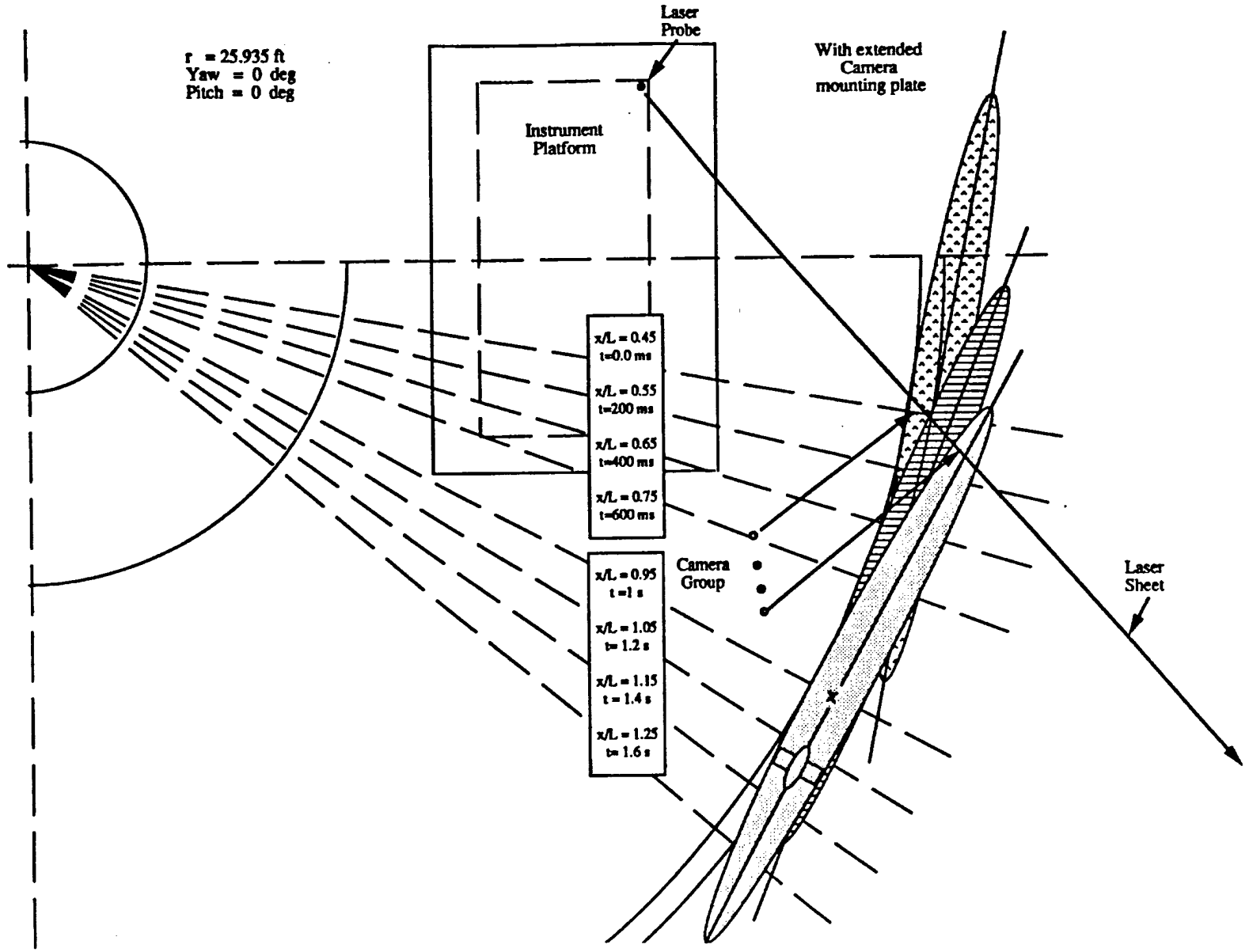


Figure A1 Yaw=0 deg.; Pitch=0 deg.; r'=L/r=0.6555.

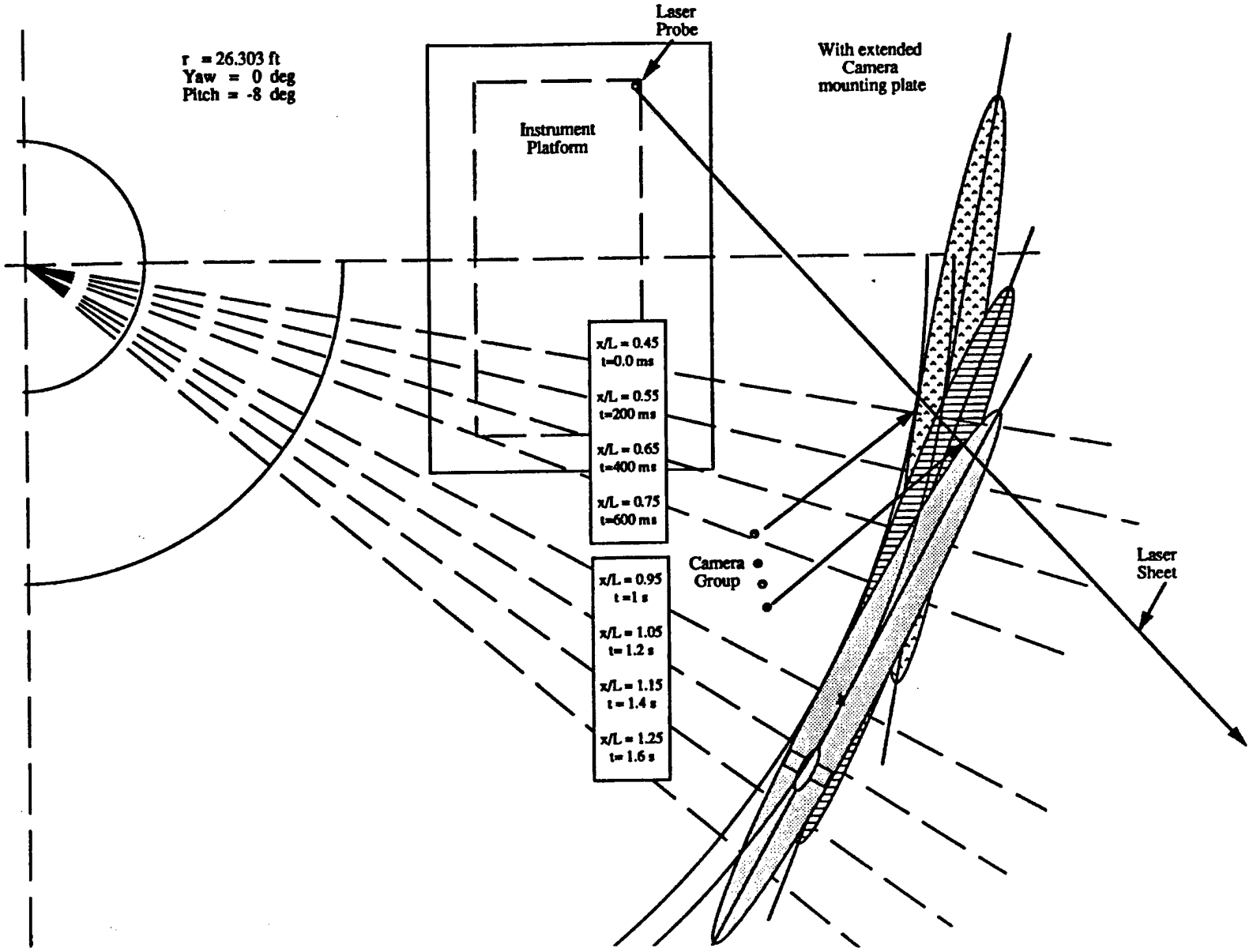


Figure A2 Yaw=0 deg.; Pitch=-8 deg.; r'=L/r=0.6400.

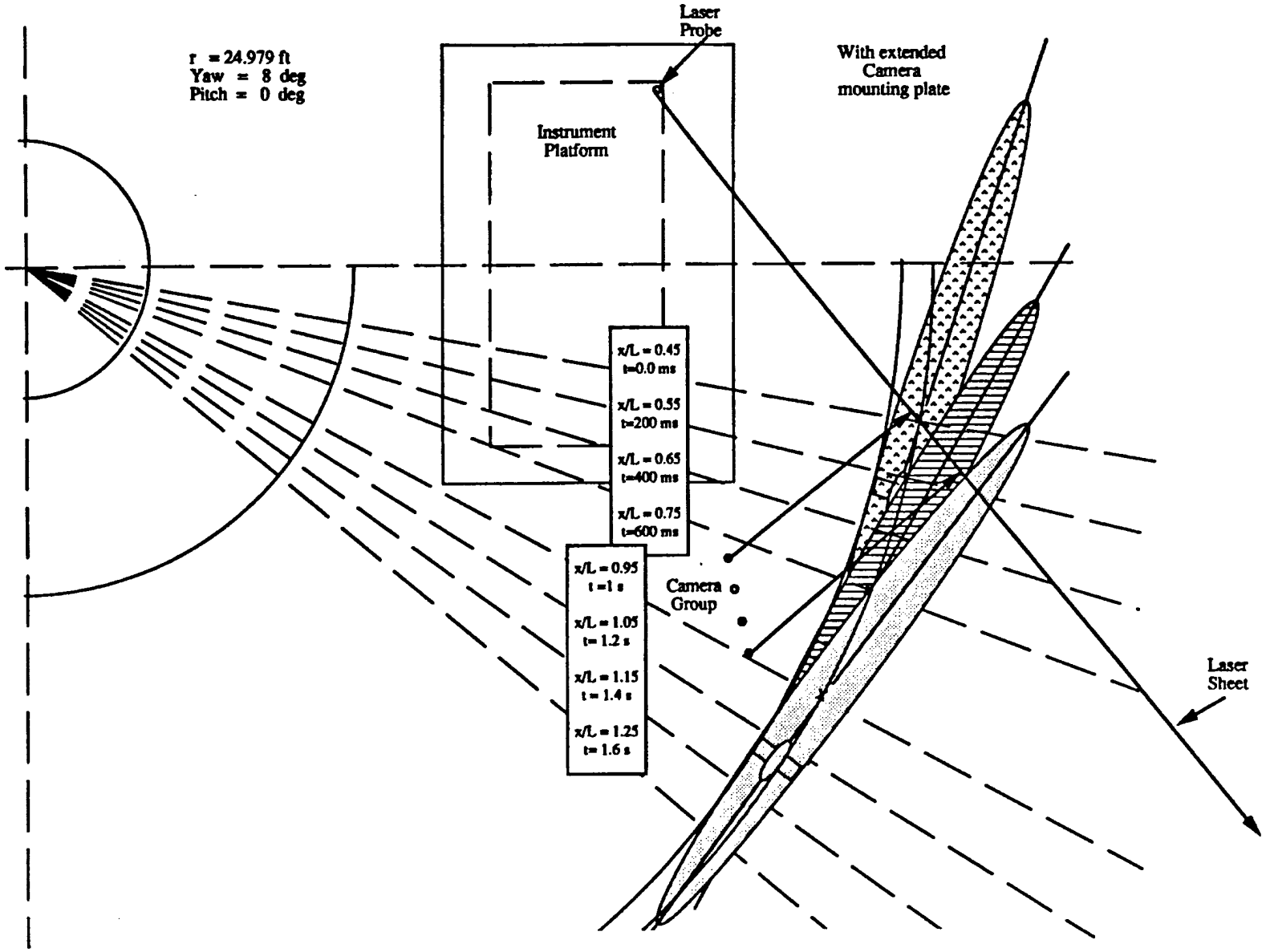


Figure A3 Yaw=8 deg.; Pitch=0 deg.; r'=L/r=0.68060.

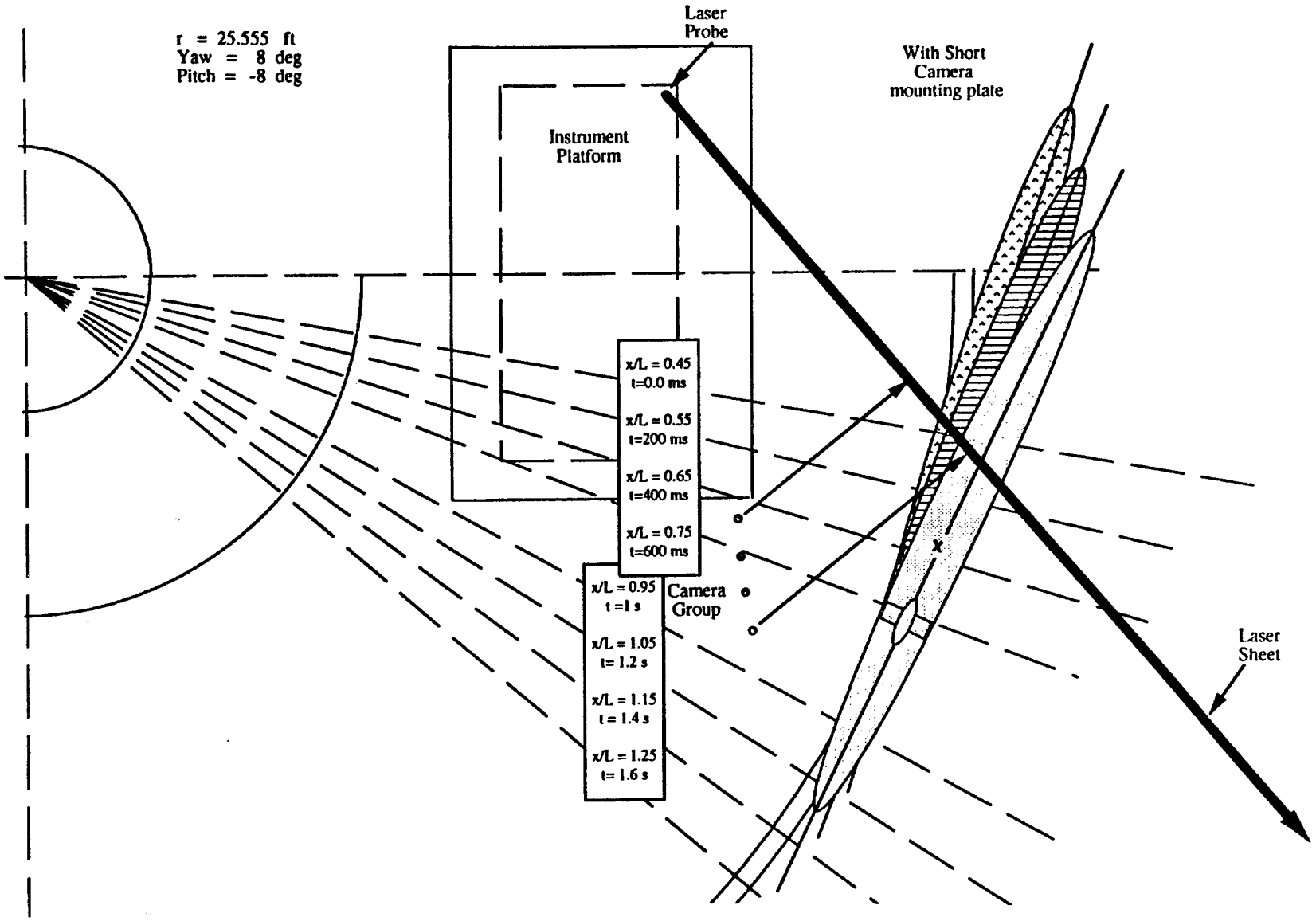


Figure A4 Yaw=8 deg.; Pitch=-8 deg.; r'=L/r=0.6588.

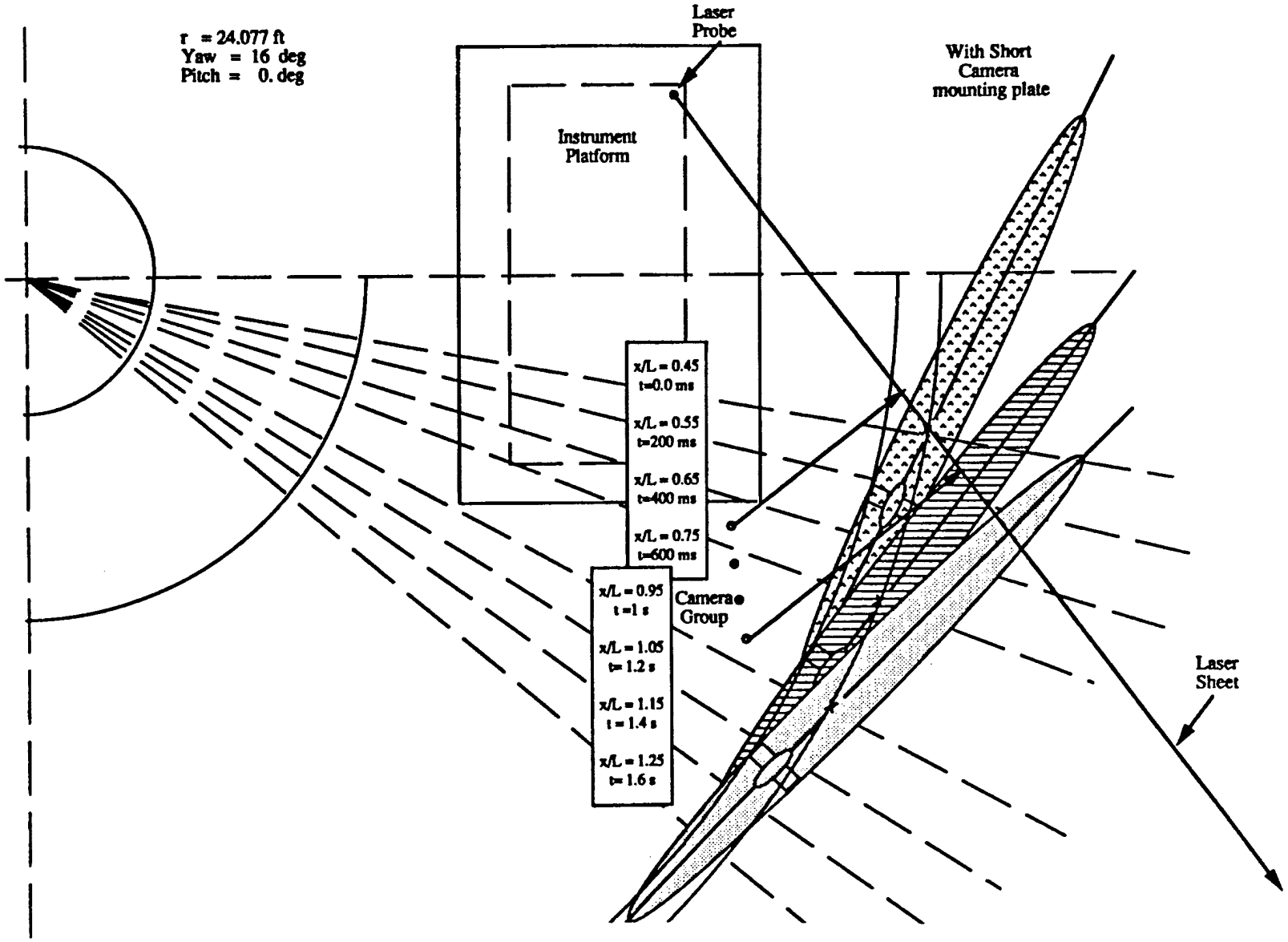


Figure A5 Yaw=16 deg.; Pitch=0 deg.; r'=L/r=0.7061.

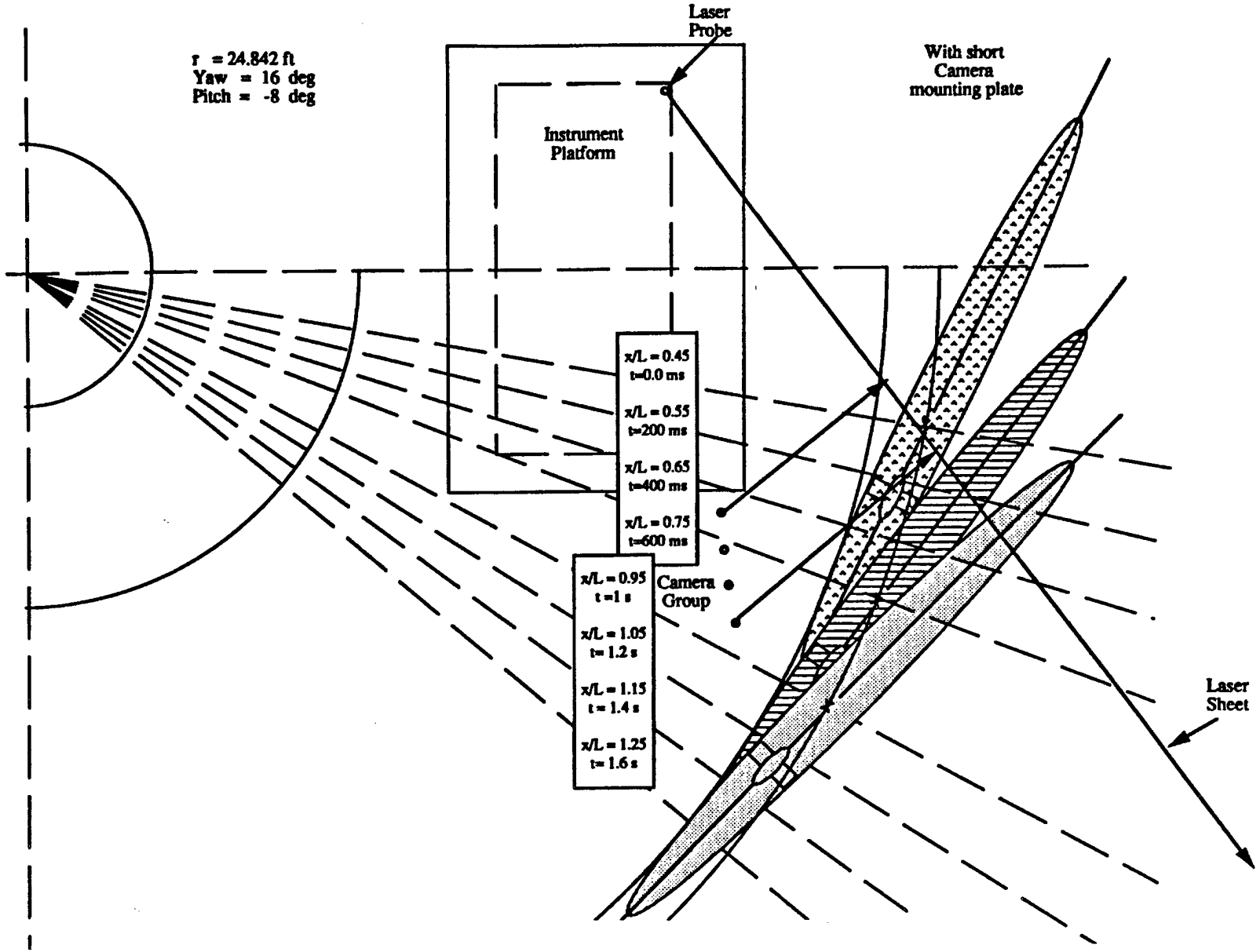


Figure A6 Yaw=16 deg.; Pitch=-8 deg.; r'=L/r=0.6777.

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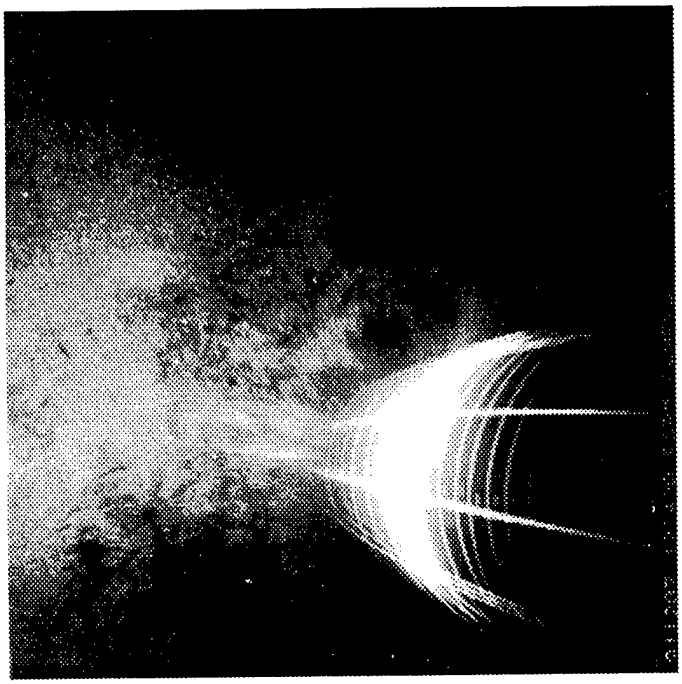
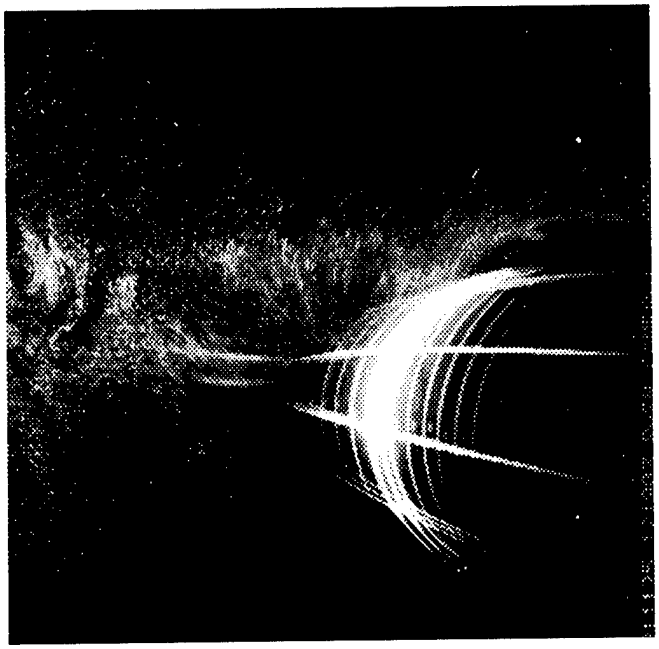
APPENDIX B

Flow Film Images from Camera No. 1 (x/L=0.75) for Various Model Configurations.



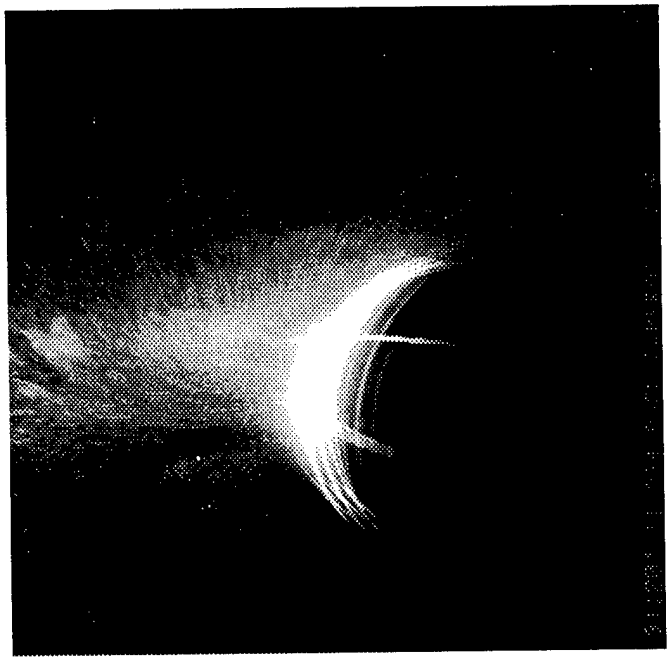
Bare Hull Model Configuration

Hull with Sail Model Configuration



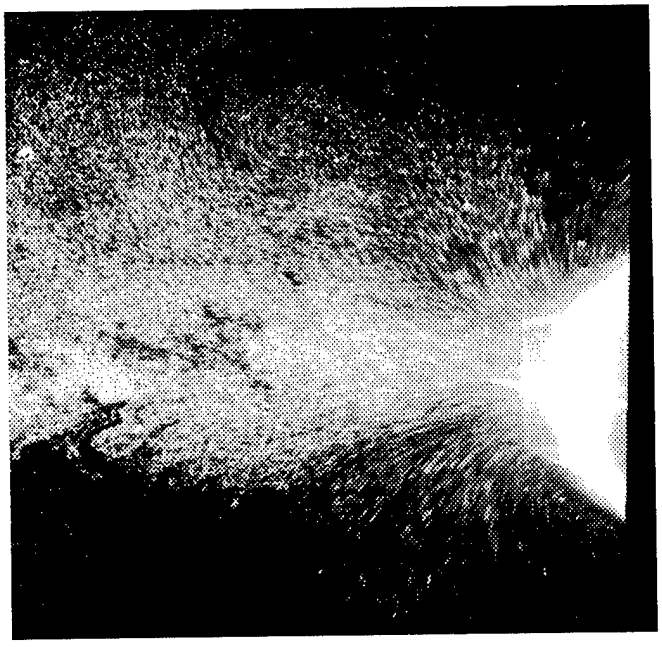
Fully Appended Model Configuration
Yaw=0°, Pitch=0°, Roll=0°

Figure B1 Flow Film Images from Camera No. 1 (x/L=0.75) for Various Model Configurations.



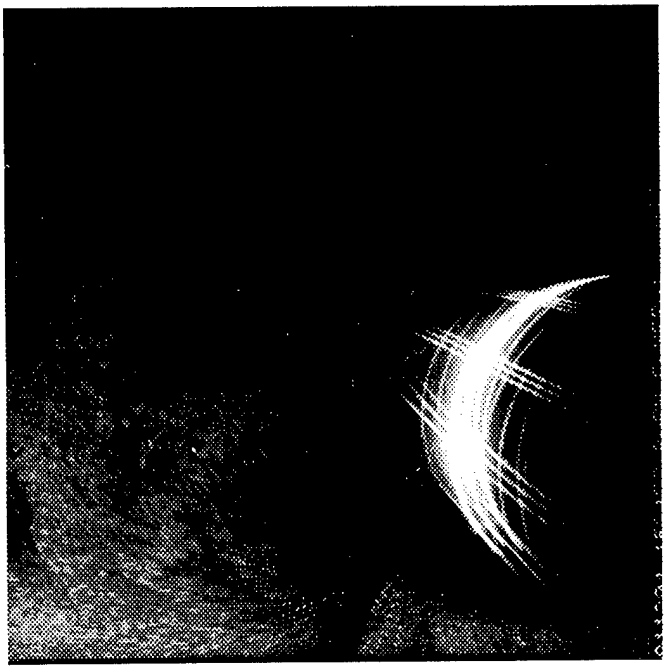
Bare Hull Model Configuration

Hull with Sail Model Configuration

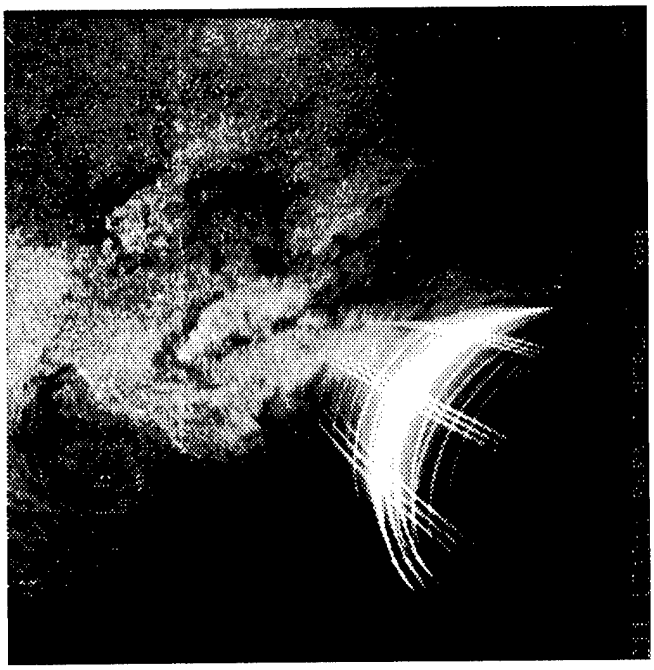


Fully Appended Model Configuration
Yaw=8°, Pitch=0°, Roll=0°

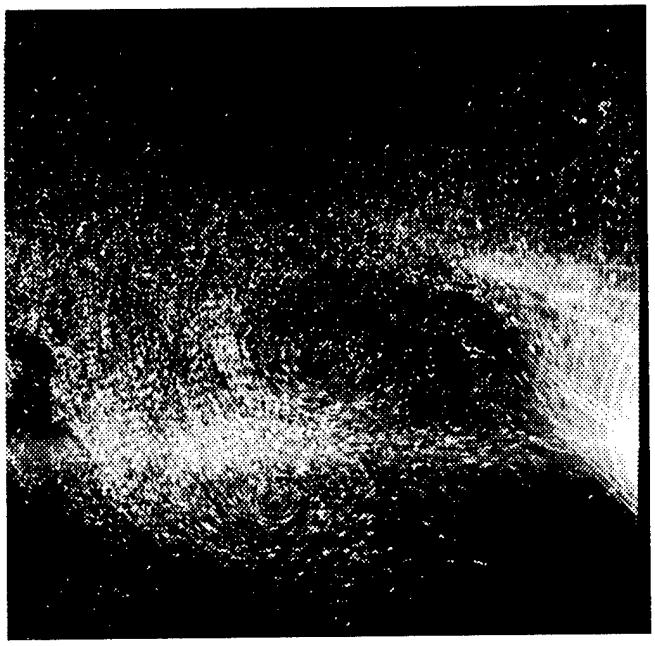
Figure B2 Flow Film Images from Camera No. 1 (x/L=0.75) for Various Model Configurations.



Bare Hull Model Configuration

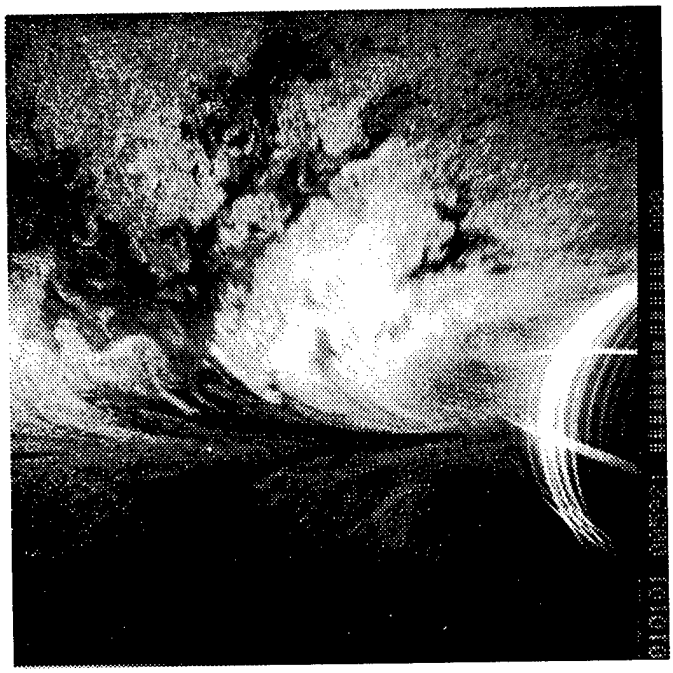


Hull with Sail Model Configuration

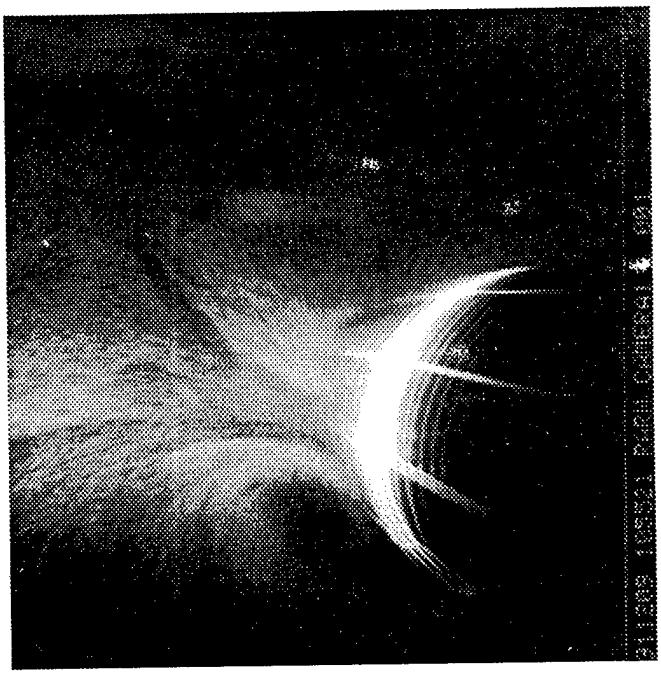


Fully Appended Model Configuration
Yaw=8°, Pitch=-8°, Roll=0°

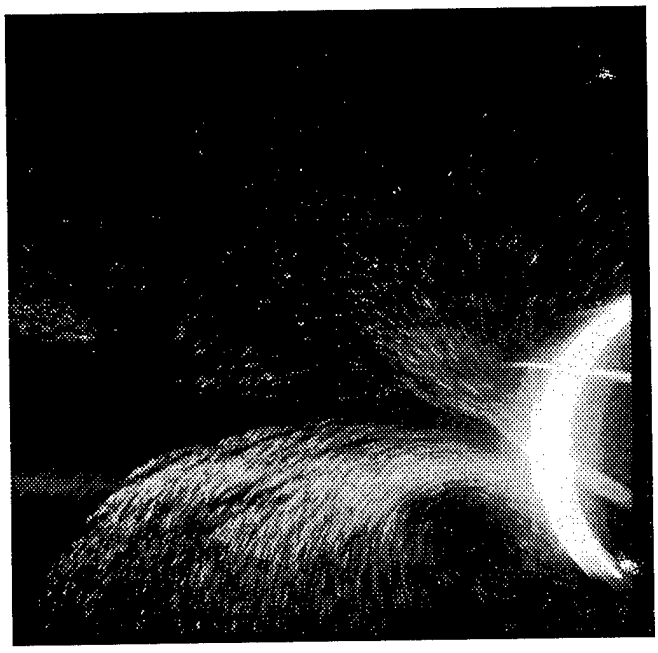
Figure B3 Flow Film Images from Camera No. 1 (x/L=0.75) for Various Model Configurations.



Bare Hull Model Configuration



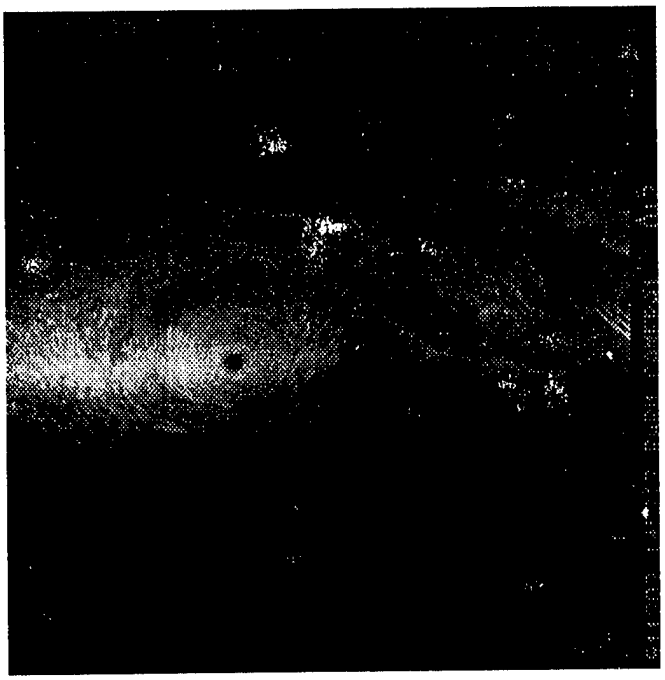
Hull with Sail Model Configuration



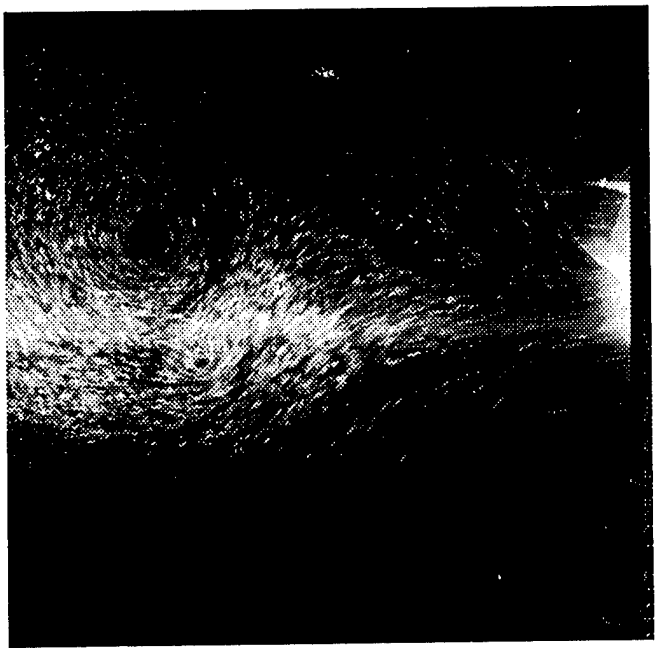
Fully Appended Model Configuration
Yaw=16°, Pitch=0°, Roll=0°

Figure B4 Flow Film Images from Camera No. 1 (x/L=0.75) for Various Model Configurations.

Bare Hull Model Configuration



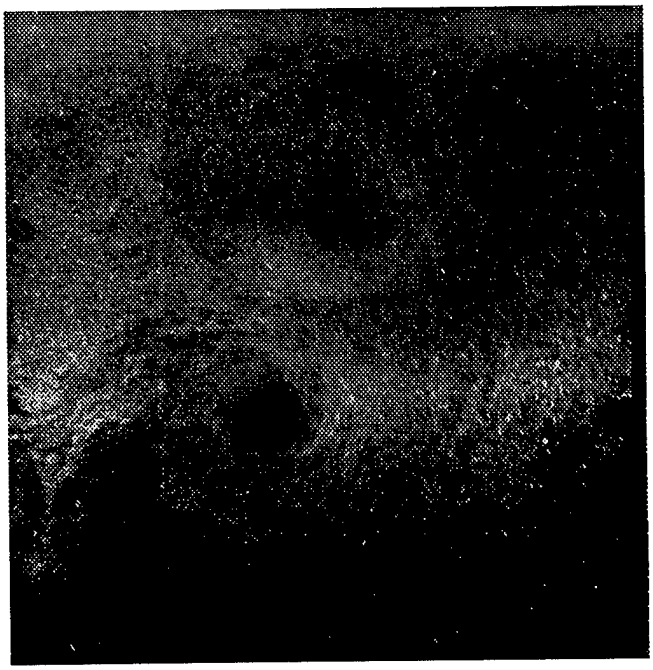
Hull with Sail Model Configuration



Fully Appended Model Configuration
Yaw=16°, Pitch=-8°, Roll=0°

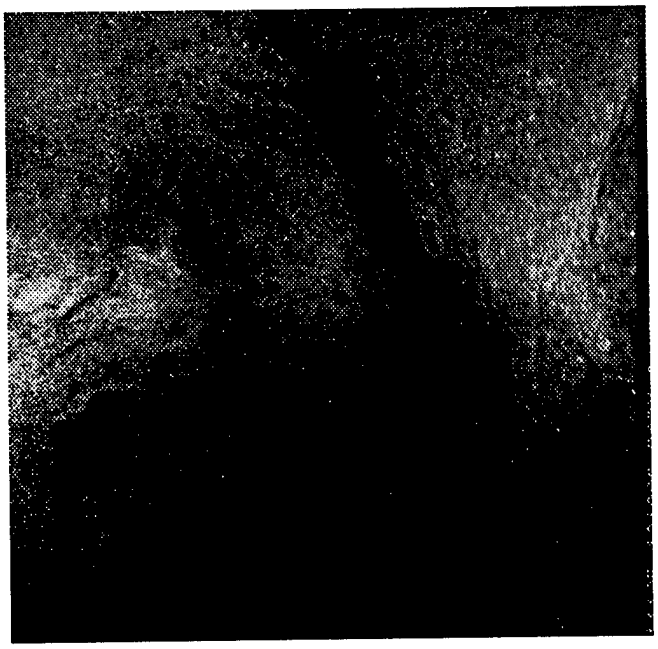
Figure B5 Flow Film Images from Camera No. 1 (x/L=0.75) for Various Model Configurations.

NO PHOTOGRAPH AVAILABLE



Bare Hull Model Configuration

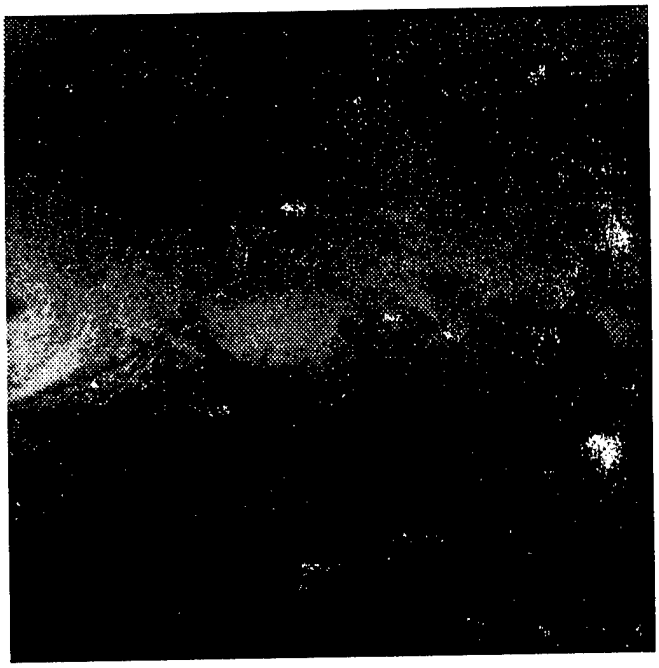
Hull with Sail Model Configuration



Fully Appended Model Configuration
Yaw=0°, Pitch=0°, Roll=0°

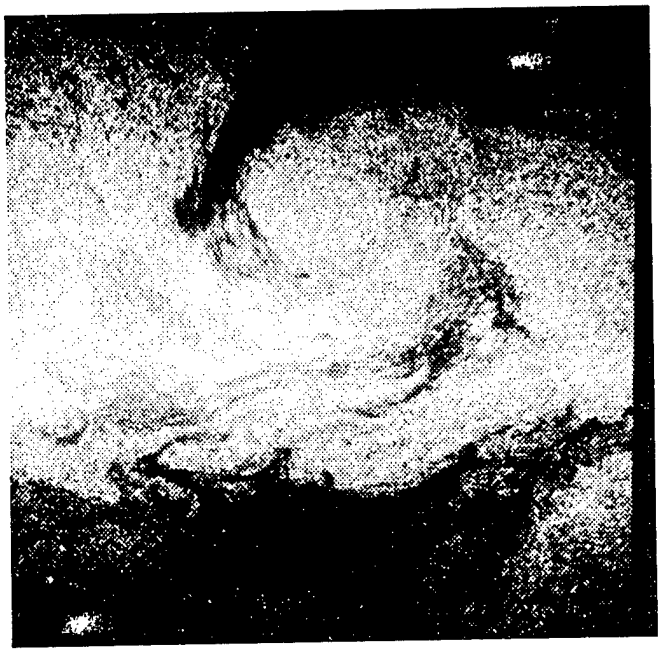
Figure B6 Flow Film Images from Camera No. 1 (x/L=0.75) for Various Model Configurations.

NO PHOTOGRAPH AVAILABLE



Bare Hull Model Configuration

Hull with Sail Model Configuration



Fully Appended Model Configuration
Yaw=8°, Pitch=0°, Roll=0°

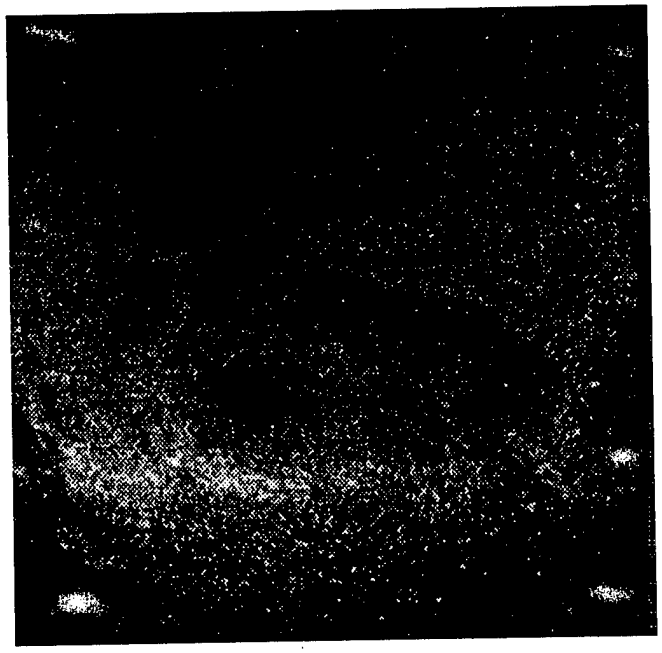
Figure B7 Flow Film Images from Camera No. 1 (x/L=0.75) for Various Model Configurations.

NO PHOTOGRAPH AVAILABLE

NO PHOTOGRAPH AVAILABLE

Bare Hull Model Configuration

Hull with Sail Model Configuration



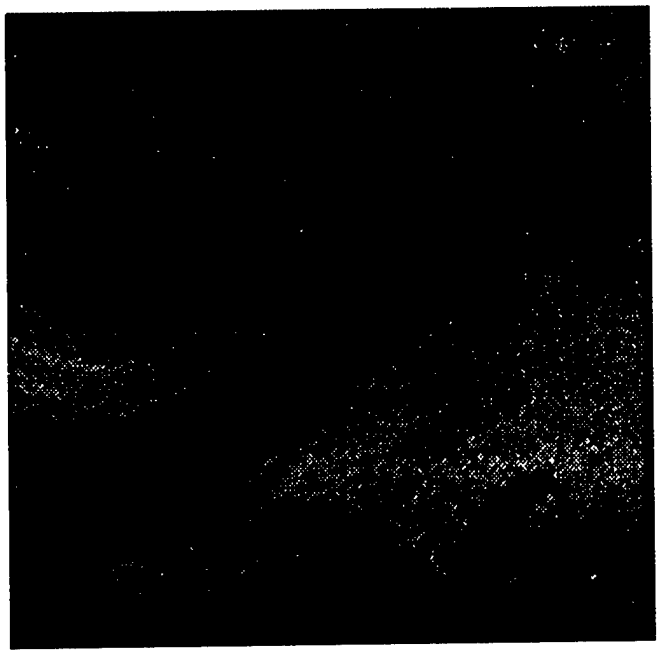
Fully Appended Model Configuration
Yaw=8°, Pitch=-8°, Roll=0°

Figure B8 Flow Film Images from Camera No. 1 (x/L=0.75) for Various Model Configurations.

NO PHOTOGRAPH AVAILABLE

Bare Hull Model Configuration

Hull with Sail Model Configuration



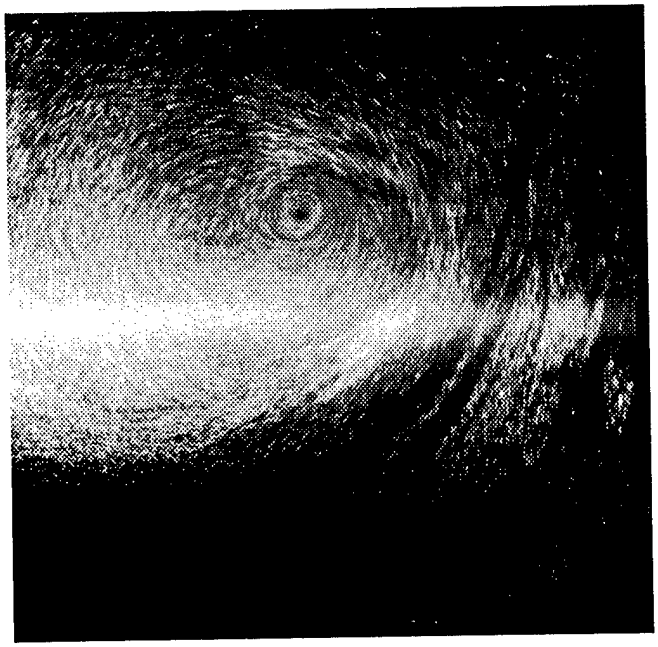
Fully Appended Model Configuration
Yaw=16°, Pitch=0°, Roll=0°

Figure B9 Flow Film Images from Camera No. 1 (x/L=0.75) for Various Model Configurations.

NO PHOTOGRAPH AVAILABLE

Bare Hull Model Configuration

Hull with Sail Model Configuration



Fully Appended Model Configuration
Yaw=16°, Pitch=-8°, Roll=0°

Figure B10 Flow Film Images from Camera No. 1 (x/L=0.75) for Various Model Configurations.

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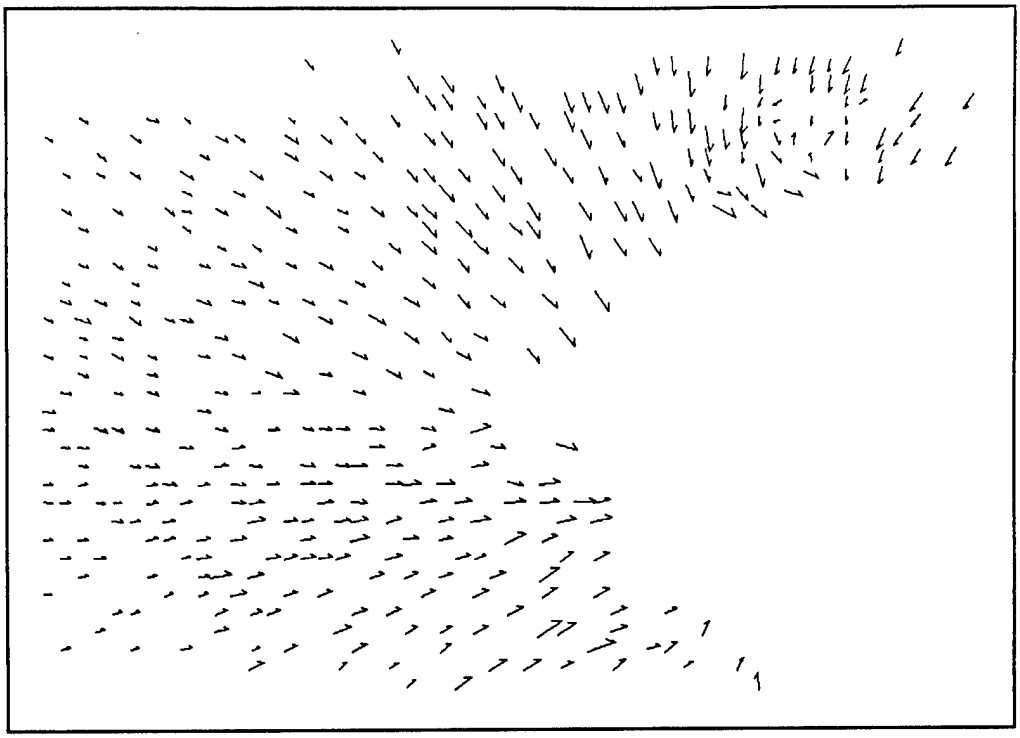
APPENDIX C

Vector plots of various model configurations

C1 Velocity vector map at x/L=0.75, bare hull configuration, yaw=0, pitch=0
C2 Velocity vector map at x/L=0.65, sail only configuration, yaw=0, pitch=0
C3 Velocity vector map at x/L=0.75, sail only configuration, yaw=0, pitch=0
C4 Velocity vector map at x/L=1.15, sail only configuration, yaw=0, pitch=0
C5 Velocity vector map at x/L=1.25, sail only configuration, yaw=0, pitch=0
C6 Velocity vector map at x/L=0.75, fully appended configuration, yaw=0, pitch=0
C7 Velocity vector map at x/L=1.15, fully appended configuration, yaw=0, pitch=0
C8 Velocity vector map at x/L=2.25, fully appended configuration, yaw=0, pitch=0
C9 Velocity vector map at x/L=0.75, bare hull configuration, yaw=8, pitch=0
C10 Velocity vector map at x/L=0.45, sail only configuration, yaw=8, pitch=0
C11 Velocity vector map at x/L=0.55, sail only configuration, yaw=8, pitch=0
C12 Velocity vector map at x/L=0.65, sail only configuration, yaw=8, pitch=0
C13 Velocity vector map at x/L=0.75, sail only configuration, yaw=8, pitch=0
C14 Velocity vector map at x/L=0.95, sail only configuration, yaw=8, pitch=0
C15 Velocity vector map at x/L=1.05, sail only configuration, yaw=8, pitch=0
C16 Velocity vector map at x/L=1.15, sail only configuration, yaw=8, pitch=0
C17 Velocity vector map at x/L=0.65, fully appended configuration, yaw=8, pitch=0
C18 Velocity vector map at x/L=0.75, fully appended configuration, yaw=8, pitch=0
C19 Velocity vector map at x/L=1.15, fully appended configuration, yaw=8, pitch=0
C20 Velocity vector map at x/L=0.75, bare hull configuration, yaw=16, pitch=0
C21 Velocity vector map at x/L=0.75, sail only configuration, yaw=16, pitch=0
C22 Velocity vector map at x/L=1.25, sail only configuration, yaw=16, pitch=0
C23 Velocity vector map at x/L=0.65, fully appended configuration, yaw=16, pitch=0
C24 Velocity vector map at x/L=0.75, fully appended configuration, yaw=16, pitch=0
C25 Velocity vector map at x/L=1.15, fully appended configuration, yaw=16, pitch=0
C26 Velocity vector map at x/L=1.25, fully appended configuration, yaw=16, pitch=0
C27 Velocity vector map at x/L=0.65, fully appended configuration, yaw=0, pitch=-8
C28 Velocity vector map at x/L=0.75, fully appended configuration, yaw=0, pitch=-8
C29 Velocity vector map at x/L=0.75, bare hull configuration, yaw=8, pitch=-8
C30 Velocity vector map at x/L=0.45, sail only configuration, yaw=8, pitch=-8
C31 Velocity vector map at x/L=0.55, sail only configuration, yaw=8, pitch=-8
C32 Velocity vector map at x/L=0.65, sail only configuration, yaw=8, pitch=-8
C33 Velocity vector map at x/L=0.75, sail only configuration, yaw=8, pitch=-8
C34 Velocity vector map at x/L=1.05, sail only configuration, yaw=8, pitch=-8
C35 Velocity vector map at x/L=1.15, sail only configuration, yaw=8, pitch=-8
C36 Velocity vector map at x/L=1.25, sail only configuration, yaw=8, pitch=-8
C37 Velocity vector map at x/L=0.65, fully appended configuration, yaw=8, pitch=-8
C38 Velocity vector map at x/L=0.75, fully appended configuration, yaw=8, pitch=-8
C39 Velocity vector map at x/L=1.15, fully appended configuration, yaw=8, pitch=-8
C40 Velocity vector map at x/L=1.25, fully appended configuration, yaw=8, pitch=-8
C41 Velocity vector map at x/L=0.75, bare hull configuration, yaw=16, pitch=0
C42 Velocity vector map at x/L=0.45, sail only configuration, yaw=16, pitch=-8
C43 Velocity vector map at x/L=0.55, sail only configuration, yaw=16, pitch=-8
C44 Velocity vector map at x/L=0.75, sail only configuration, yaw=16, pitch=-8
C45 Velocity vector map at x/L=1.25, sail only configuration, yaw=16, pitch=-8
C46 Velocity vector map at x/L=0.65, fully appended configuration, yaw=16, pitch=--8
C47 Velocity vector map at x/L=0.75, fully appended configuration, yaw=16, pitch=--8
C48 Velocity vector map at x/L=1.25, fully appended configuration, yaw=16, pitch=-8



NO PHOTOGRAPH AVAILABLE

Figure C1 Velocity vector map at x/L=0.75, bare hull configuration, yaw=0, pitch=0 and roll=0.

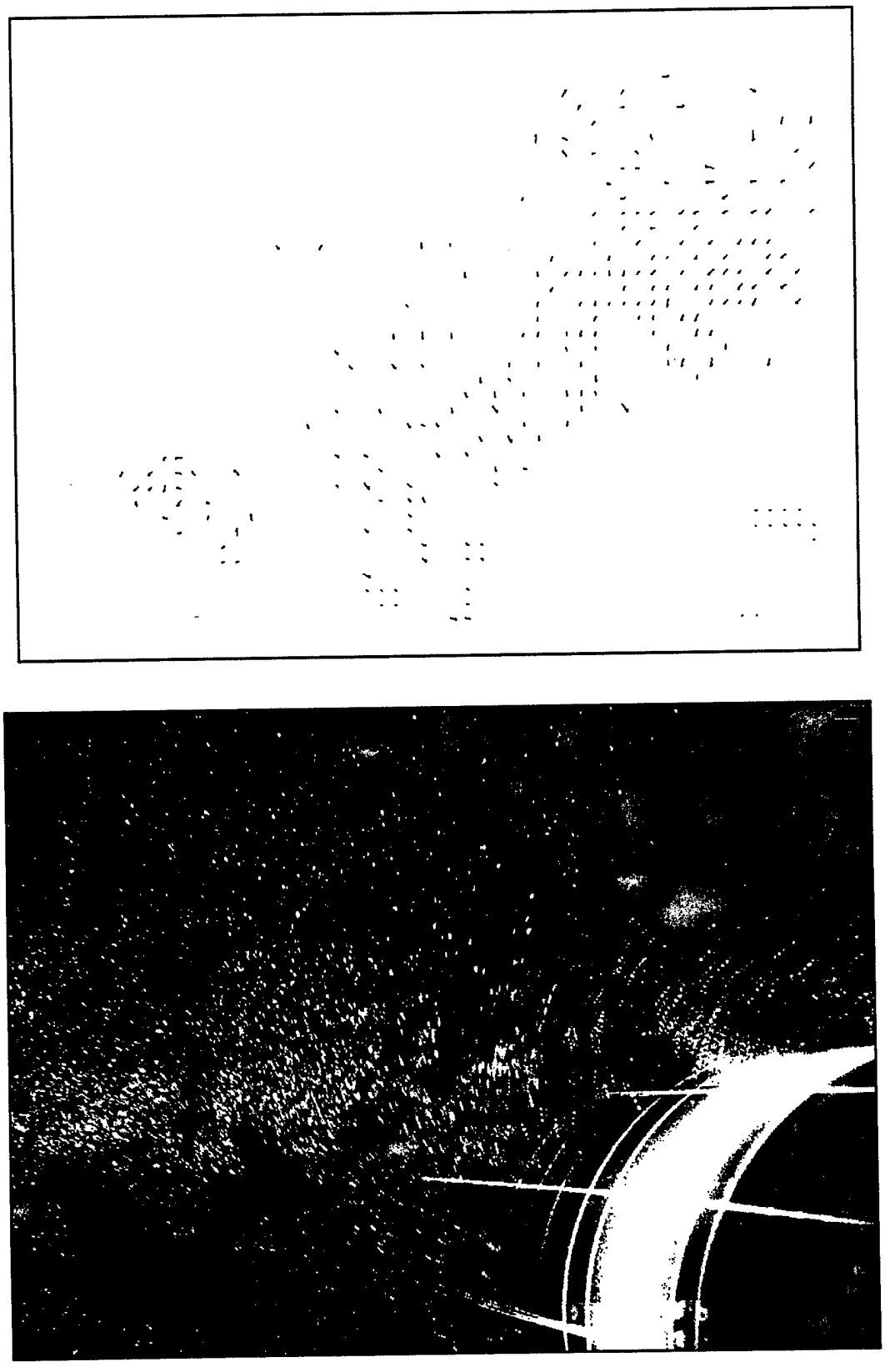


Figure C2 Velocity vector map at x/L=0.65, sail only configuration, yaw=0, pitch=0 and roll=0.

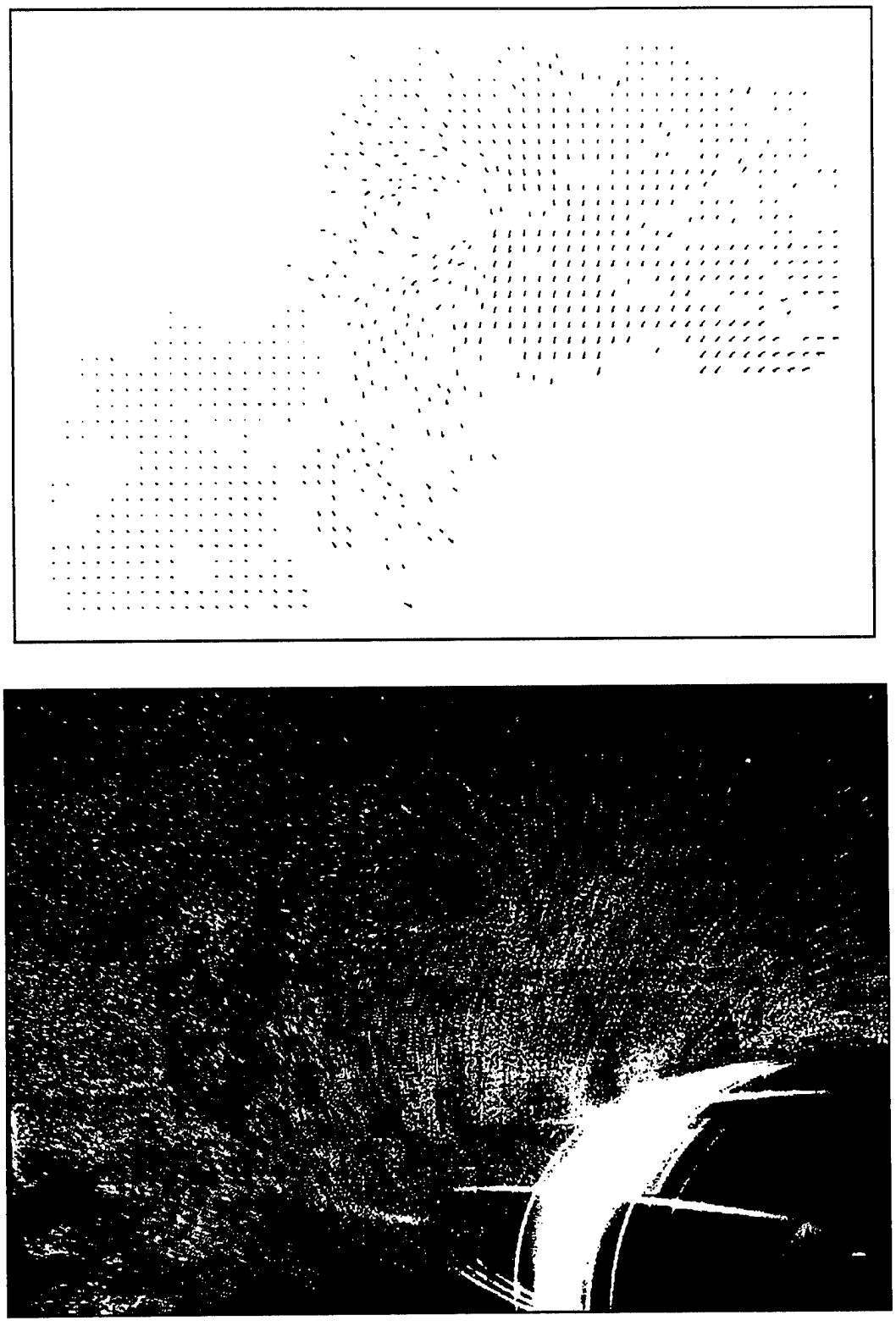


Figure C3 Velocity vector map at x/L=0.75, sail only configuration, yaw=0, pitch=0 and roll=0.

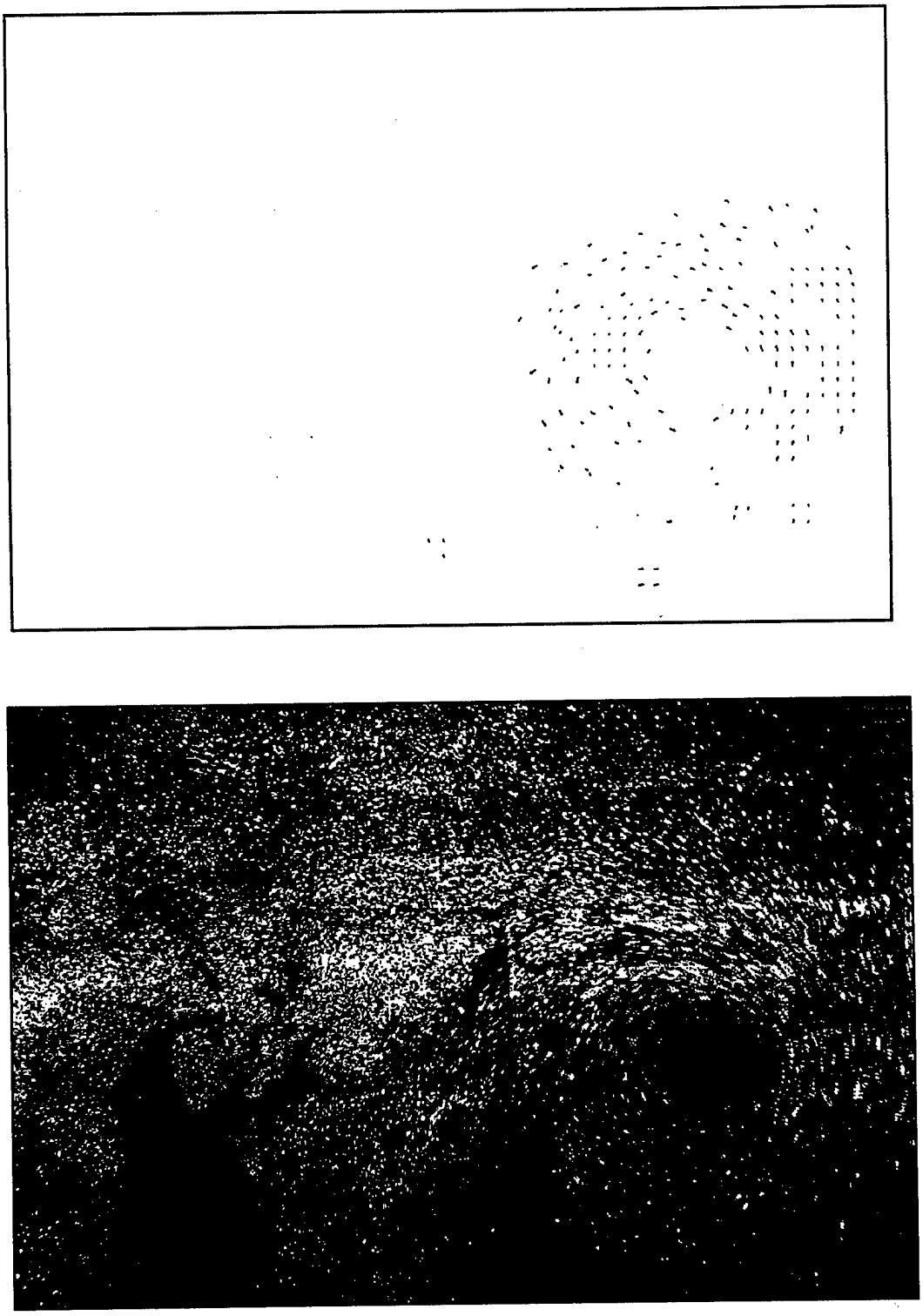


Figure C4 Velocity vector map at x/L=1.15, sail only configuration, yaw=0, pitch=0 and roll=0.

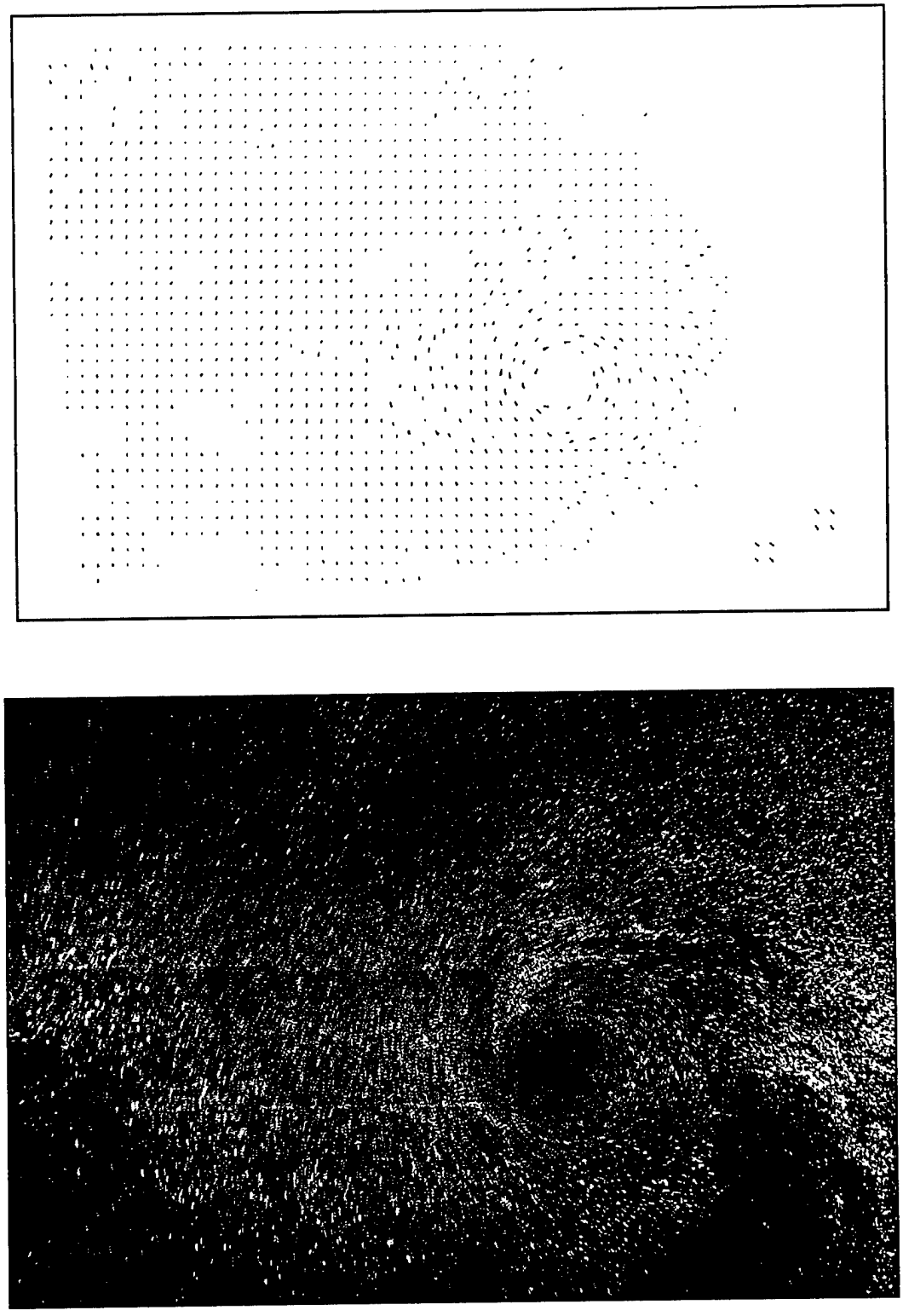
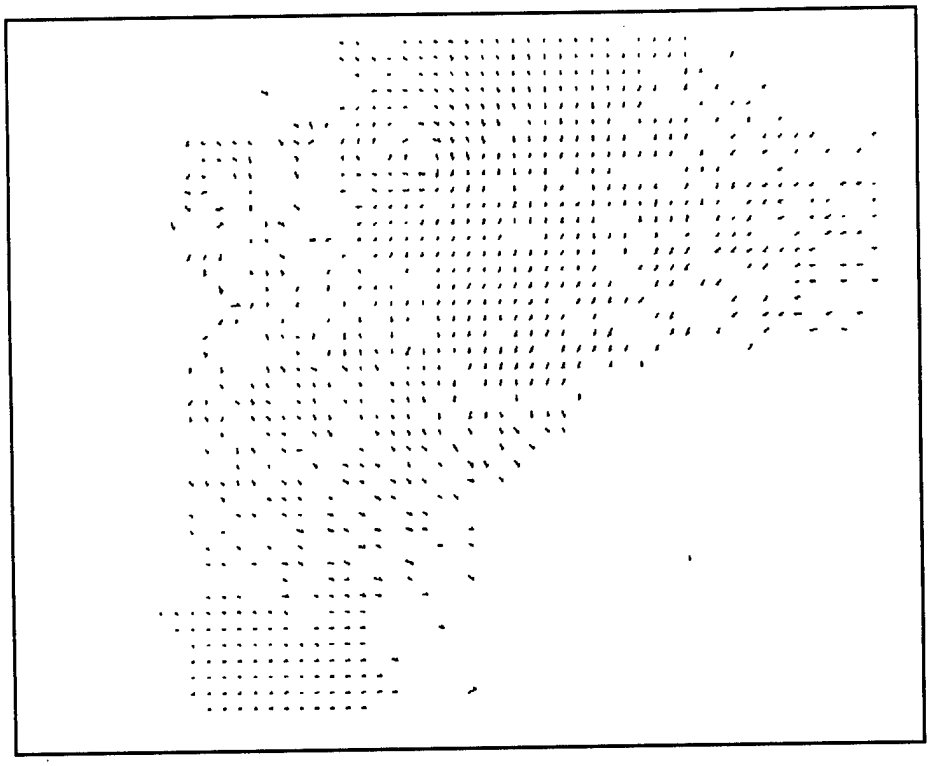


Figure C5 Velocity vector map at x/L=1.25, sail only configuration, yaw=0, pitch=0 and roll=0.



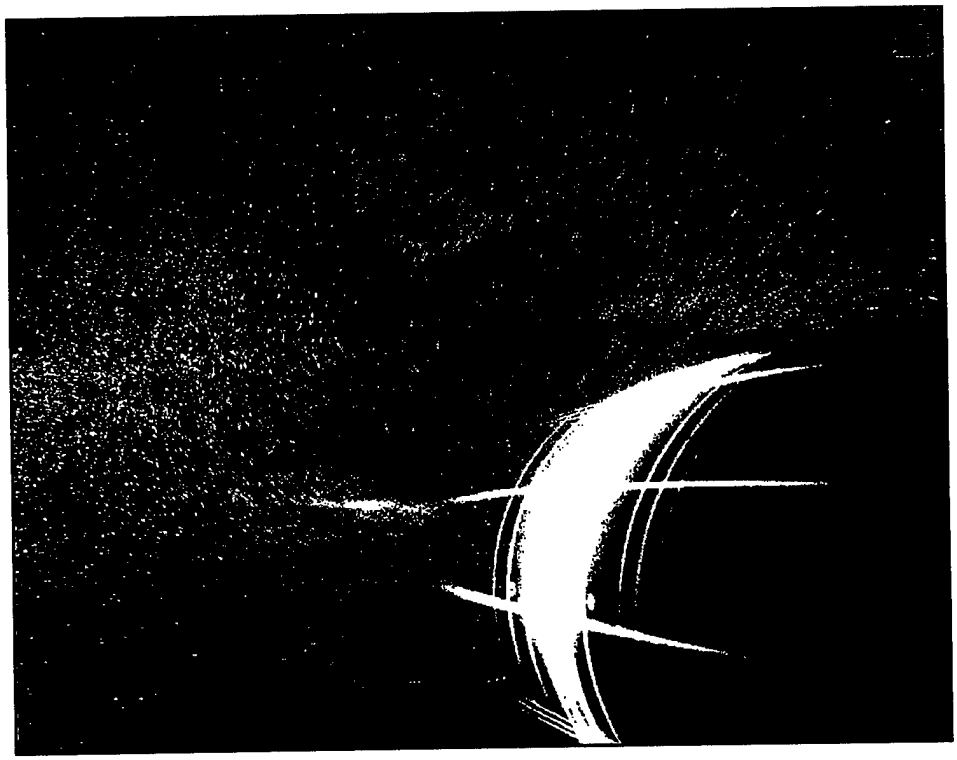


Figure C6 Velocity vector map at x/L=0.75, fully appended configuration, yaw=0, pitch=0 and roll=0.

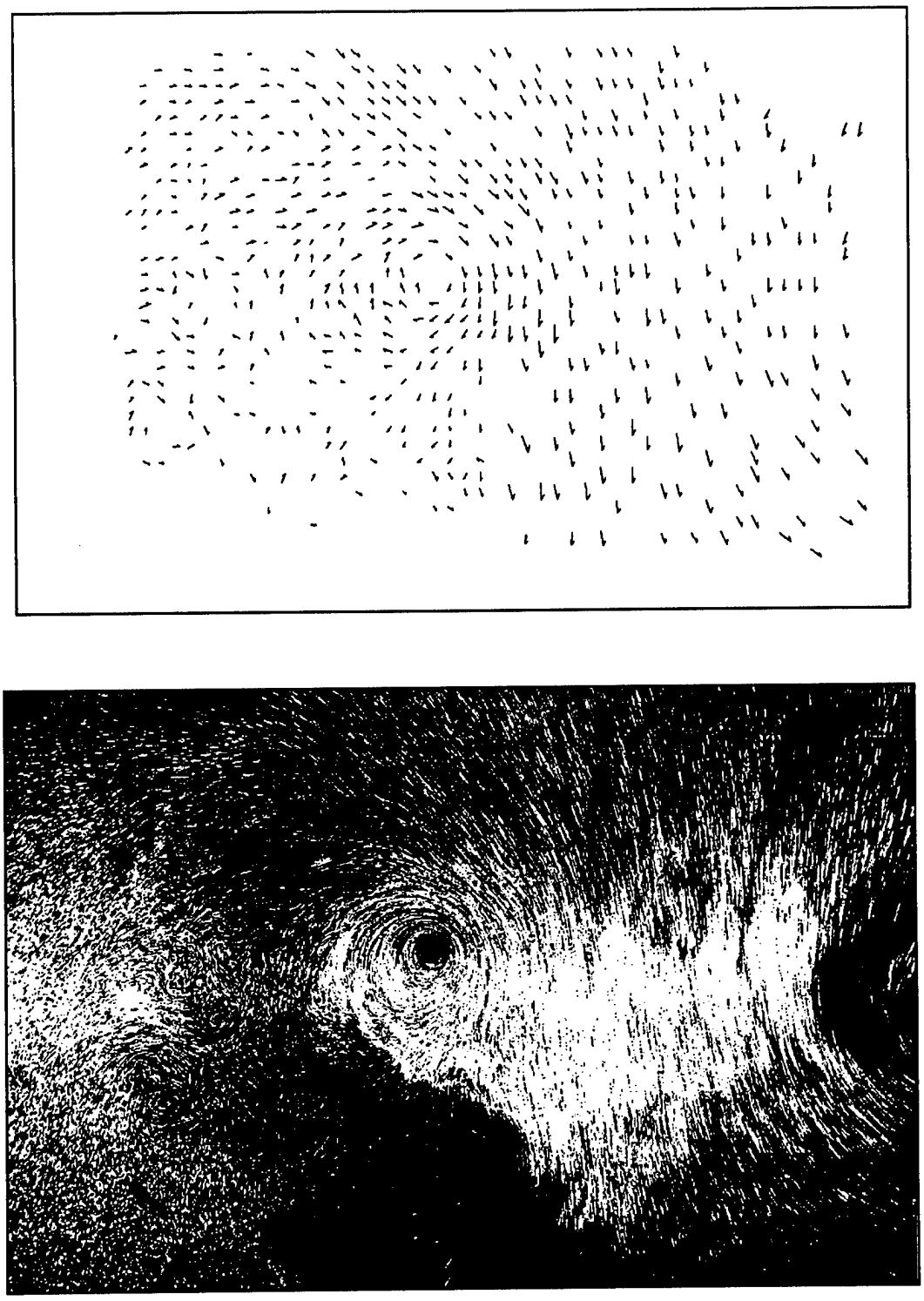


Figure C7 Velocity vector map at x/L=1.25, fully appended configuration, yaw=0, pitch=0 and roll=0.

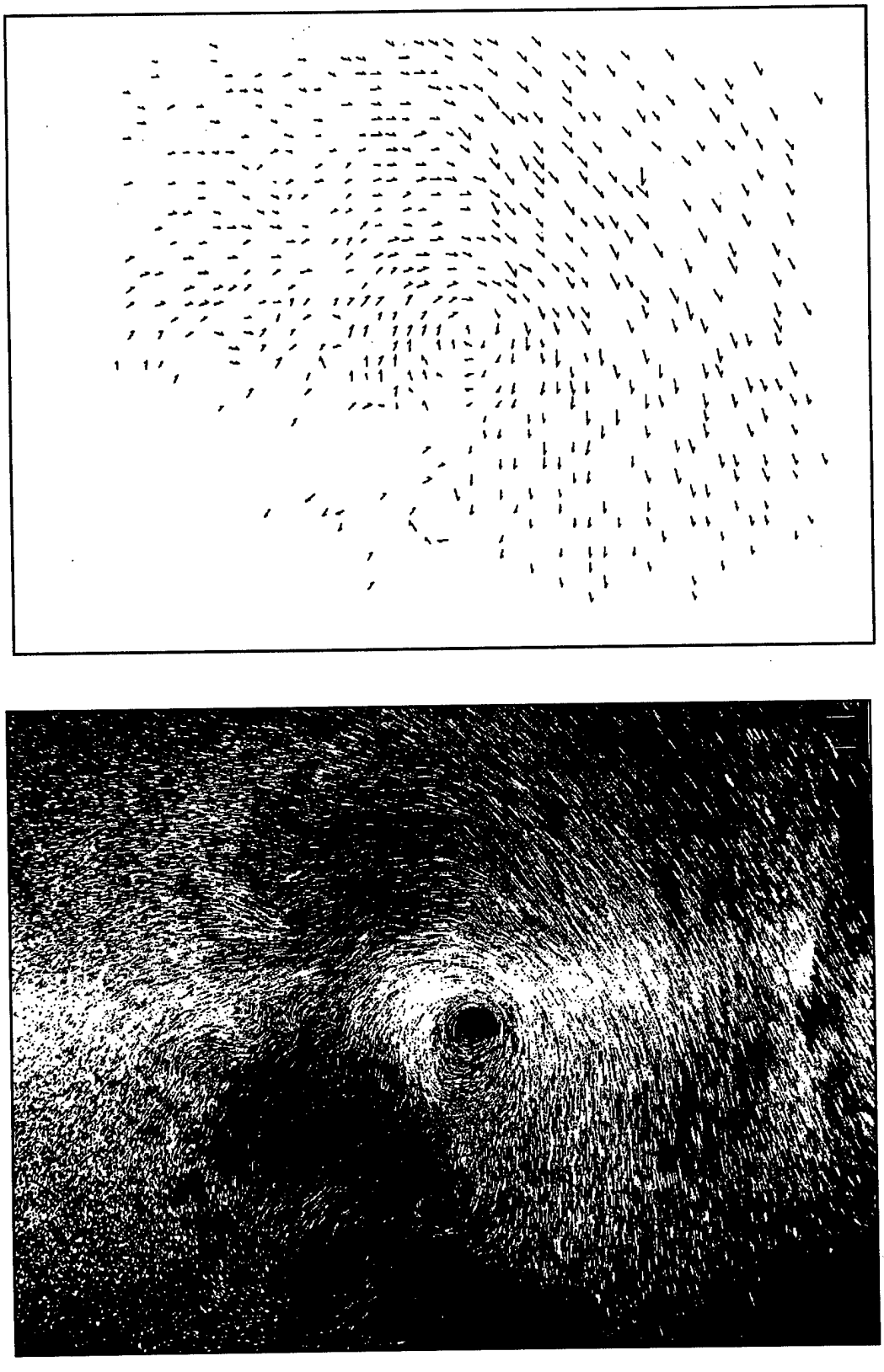
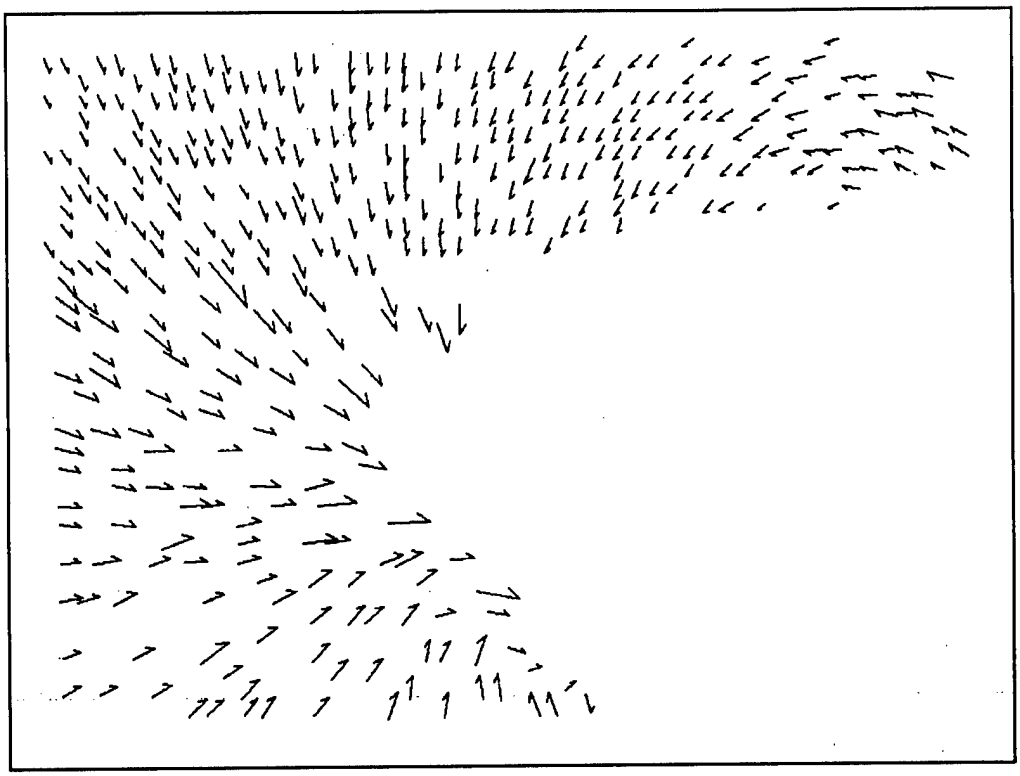


Figure C8 Velocity vector map at x/L=2.25, fully appended configuration, yaw=0, pitch=0 and roll=0.



NO PHOTOGRAPH AVAILABLE

Figure C9 Velocity vector map at x/L=0.75, bare hull configuration, yaw=8, pitch=0 and roll=0.

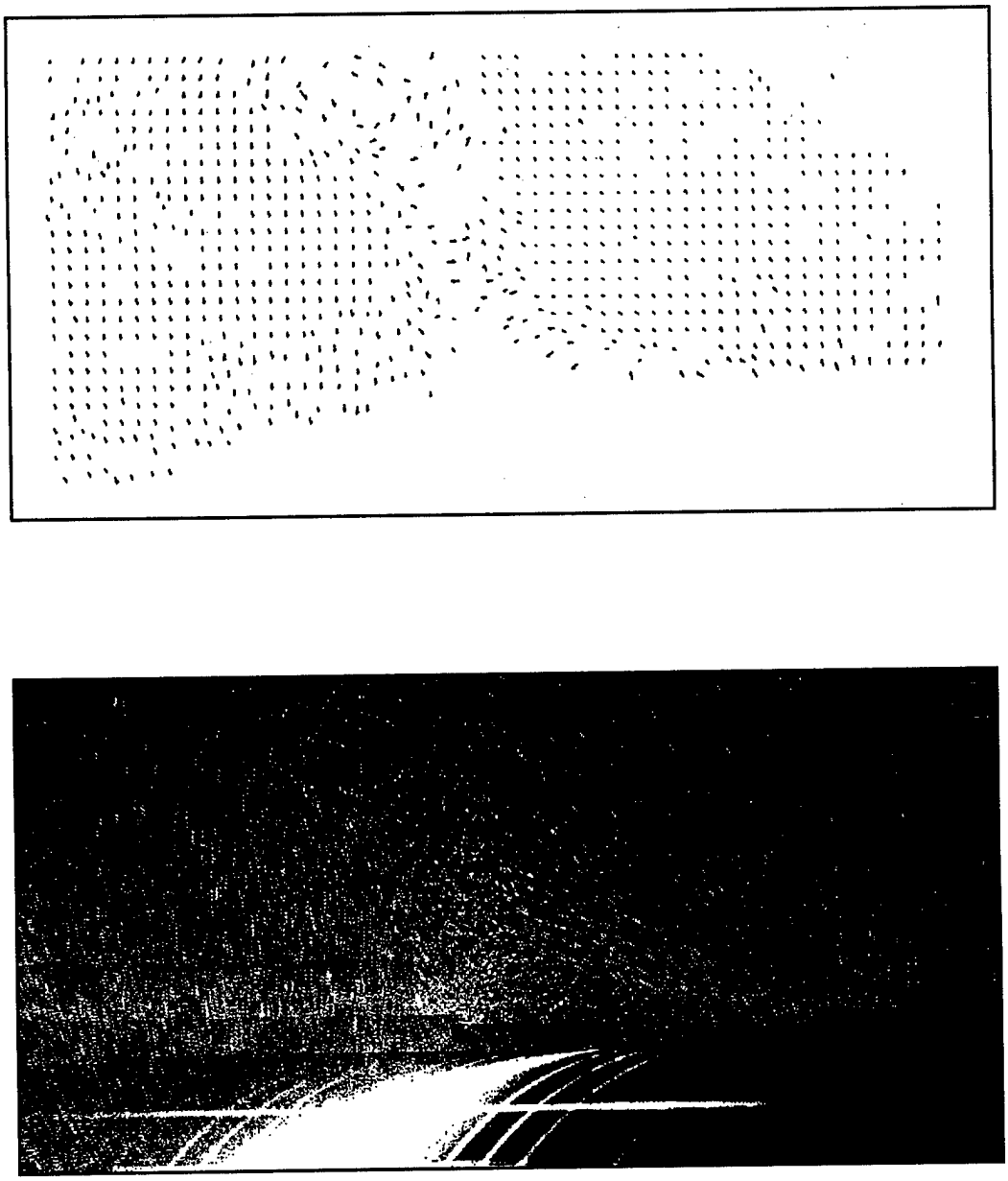


Figure C10 Velocity vector map at x/L=0.45, sail only configuration, yaw=8, pitch=0 and roll=0.

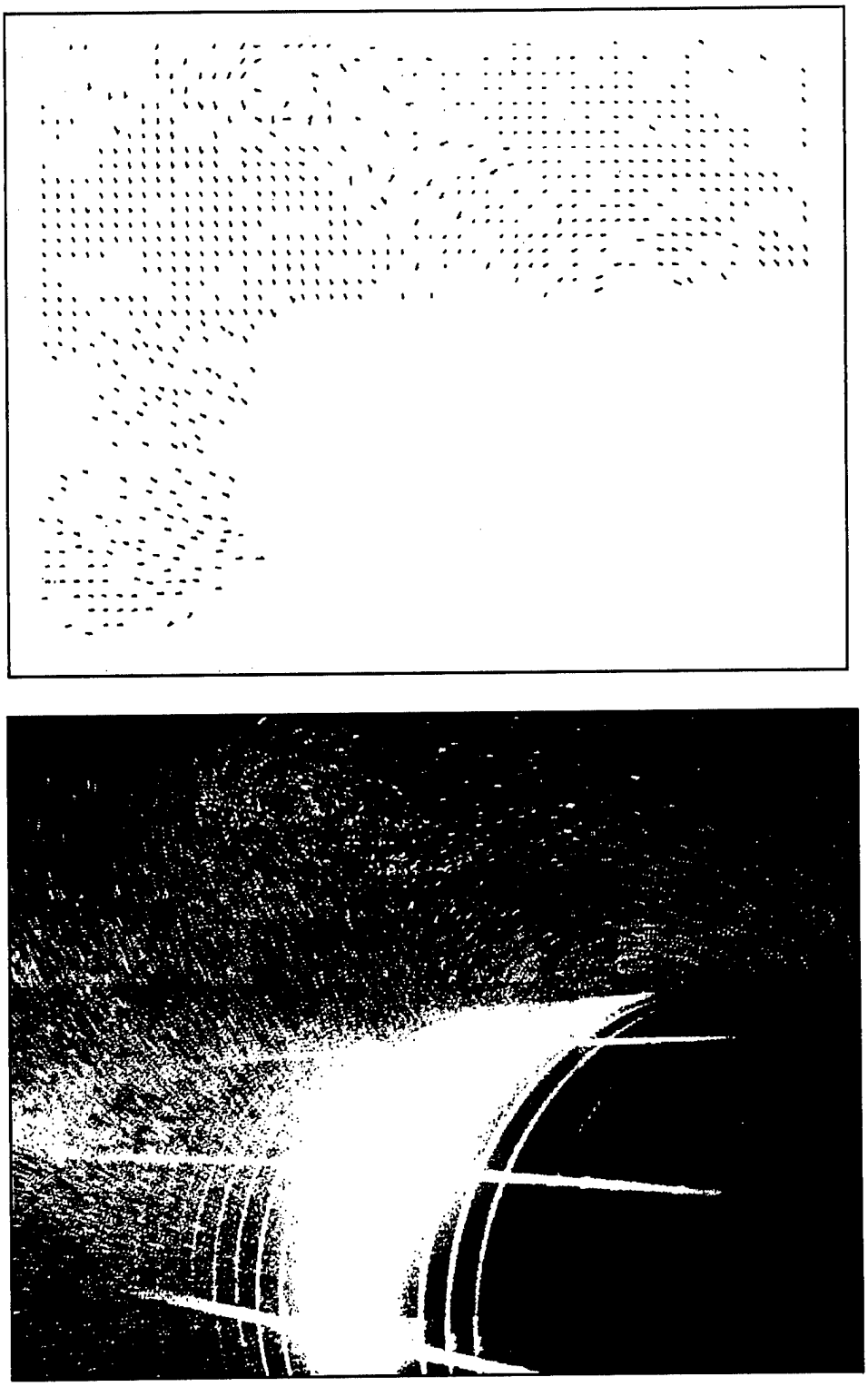


Figure C11 Velocity vector map at x/L=0.55, sail only configuration, yaw=8, pitch=0 and roll=0.

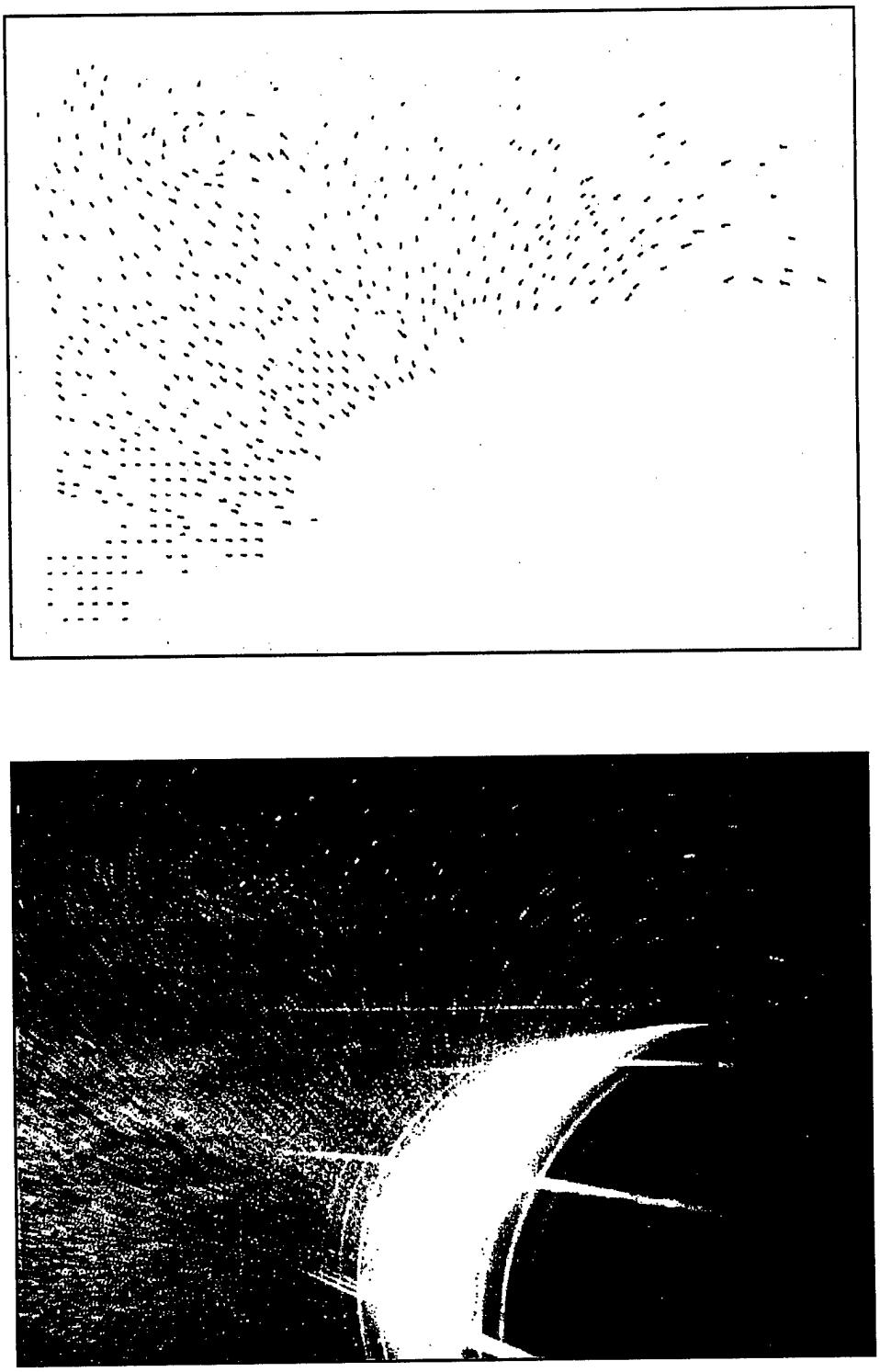
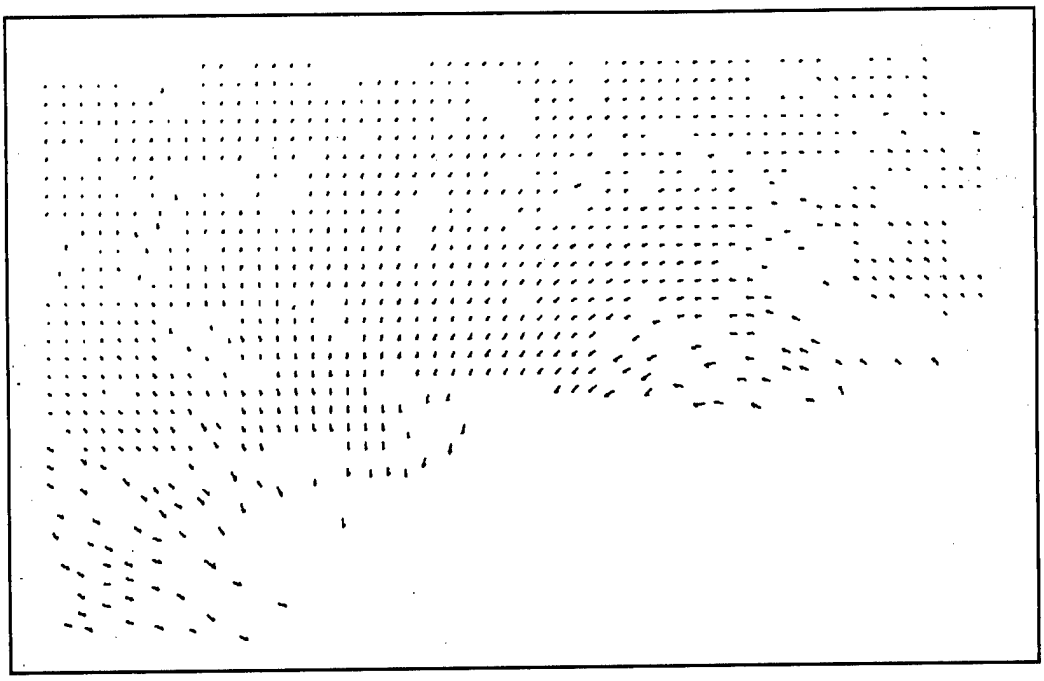


Figure C12 Velocity vector map at x/L=0.65, sail only configuration, yaw=8, pitch=0 and roll=0.



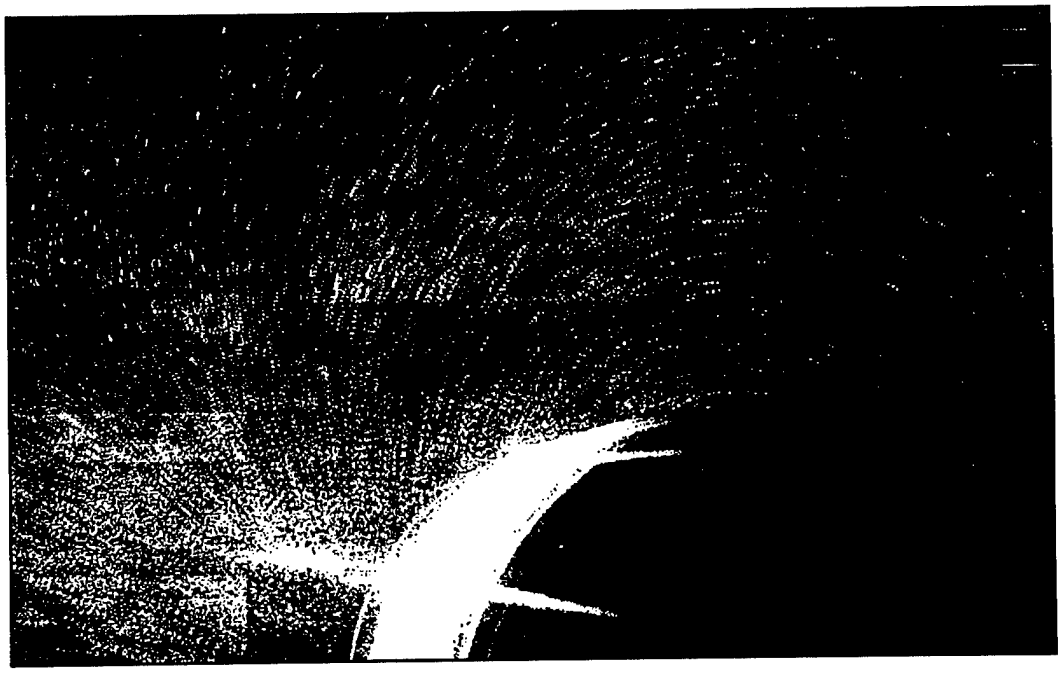
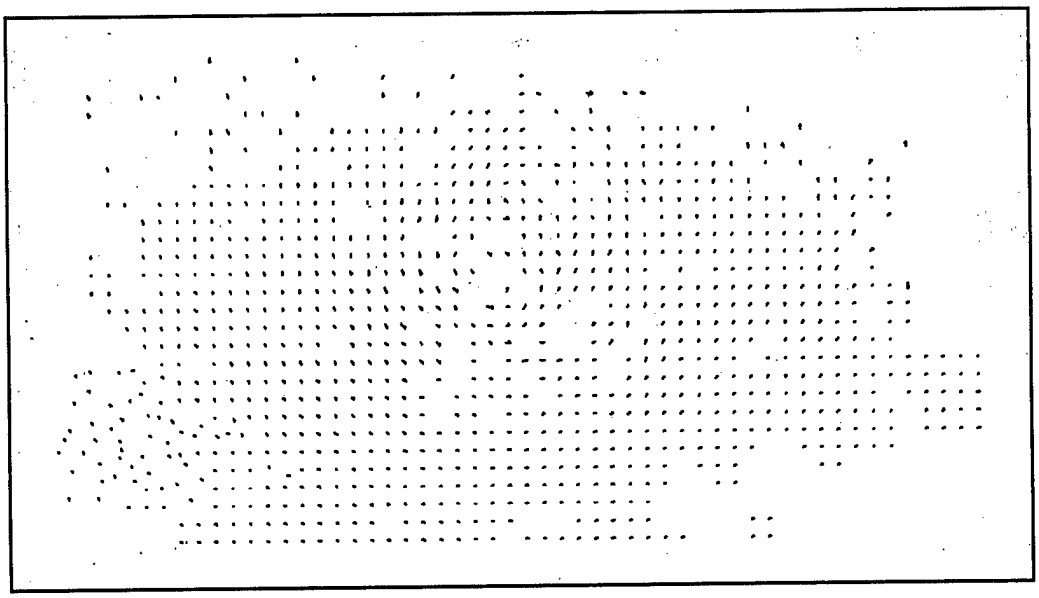


Figure C13 Velocity vector map at x/L=0.75, sail only configuration, yaw=8, pitch=0 and roll=0.



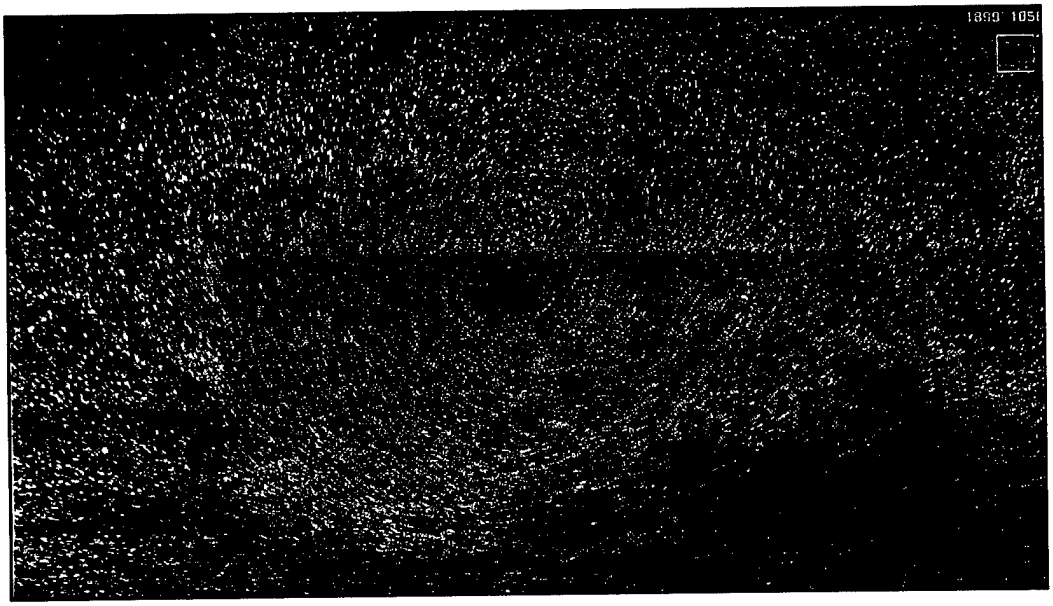
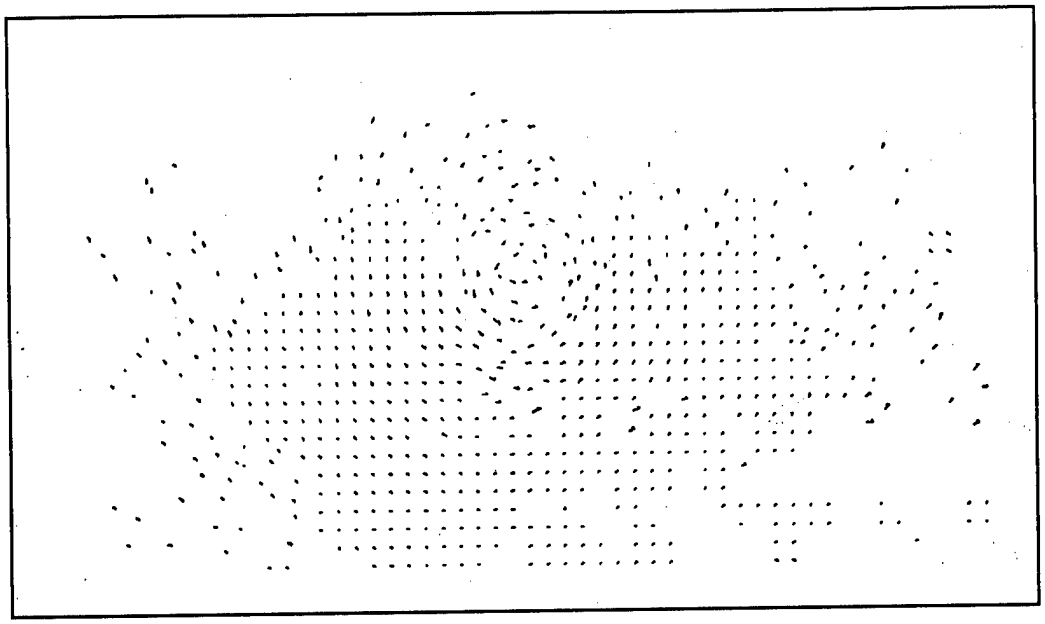


Figure C14 Velocity vector map at x/L=0.95, sail only configuration, yaw=8, pitch=0 and roll=0.



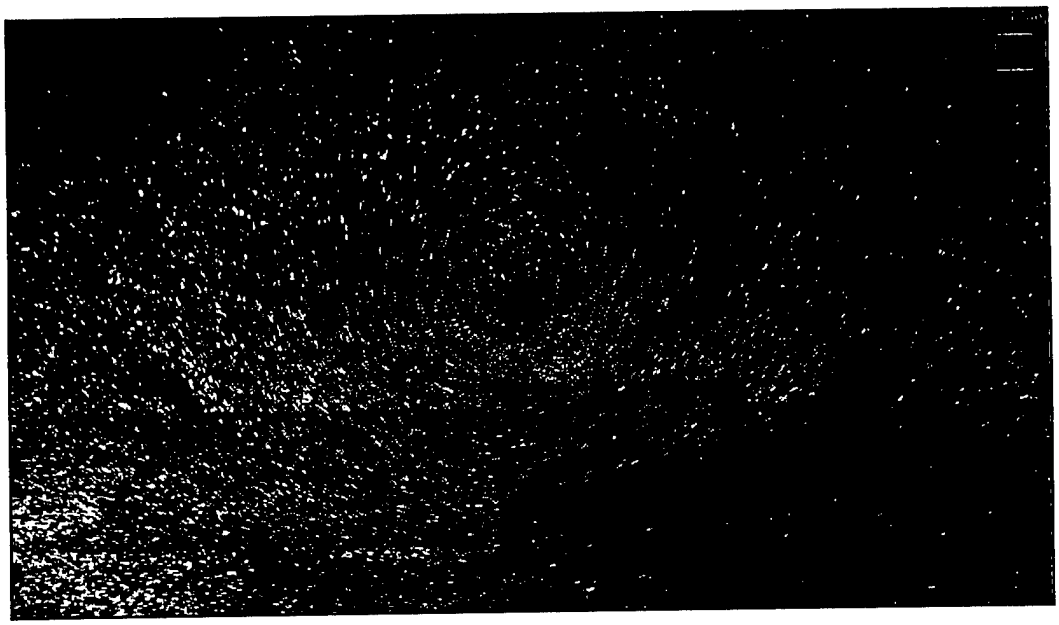


Figure C15 Velocity vector map at x/L=1.05, sail only configuration, yaw=8, pitch=0 and roll=0.

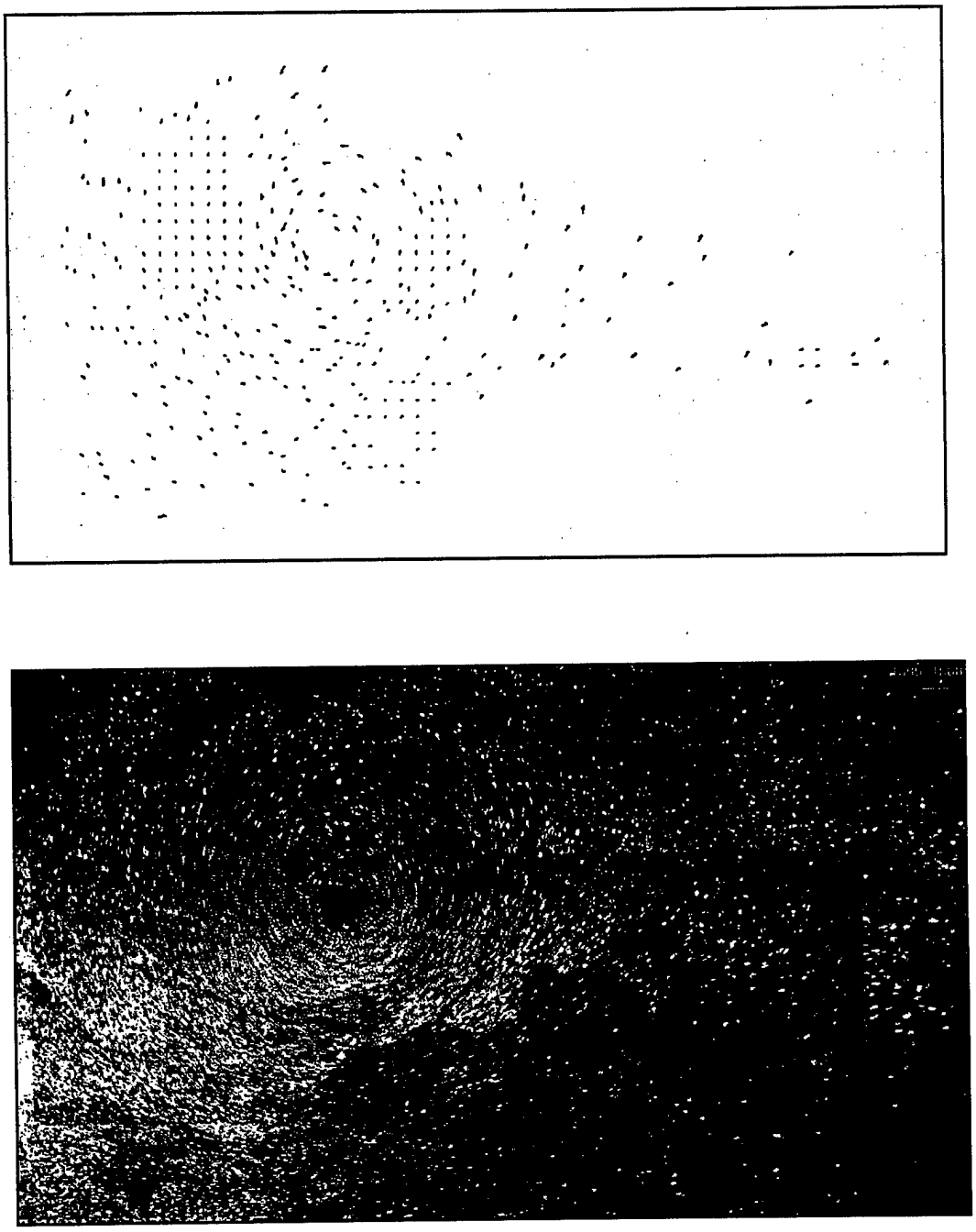


Figure C16 Velocity vector map at x/L=1.15, sail only configuration, yaw=8, pitch=0 and roll=0.

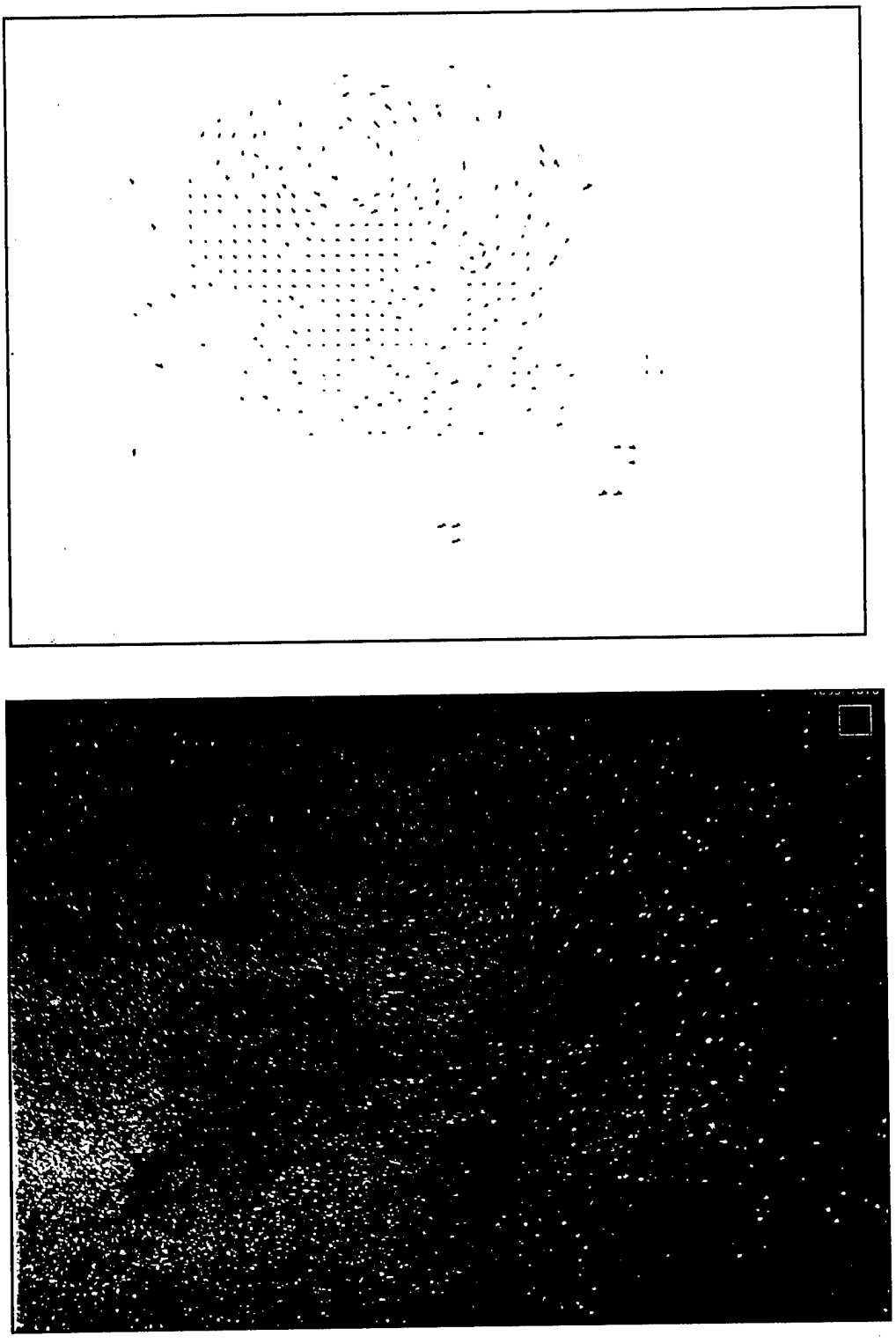


Figure C17 Velocity vector map at x/L=0.65, fully appended configuration, yaw=8, pitch=0 and roll=0.

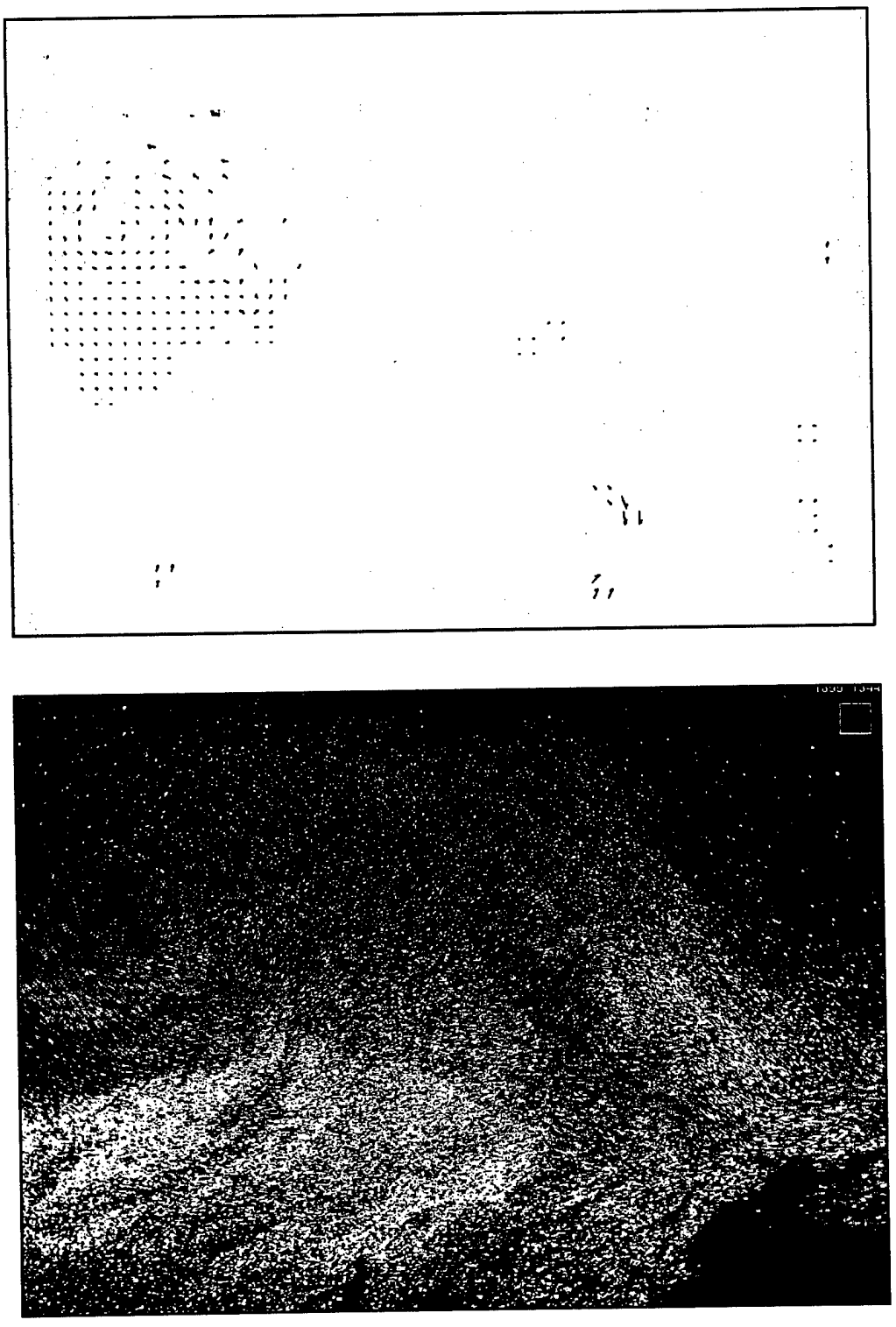


Figure C18 Velocity vector map at x/L=0.75, fully appended configuration, yaw=8, pitch=0 and roll=0.

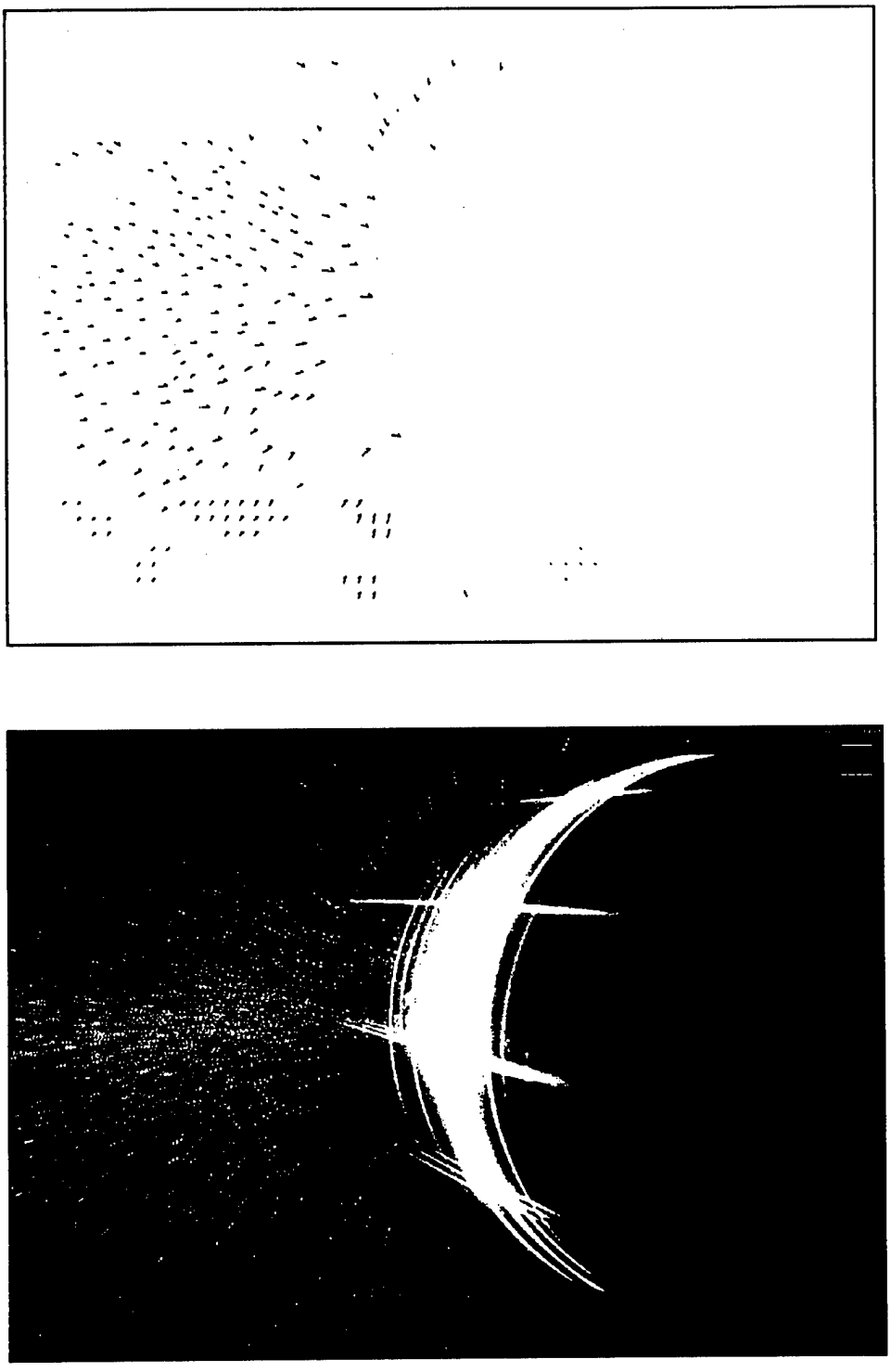
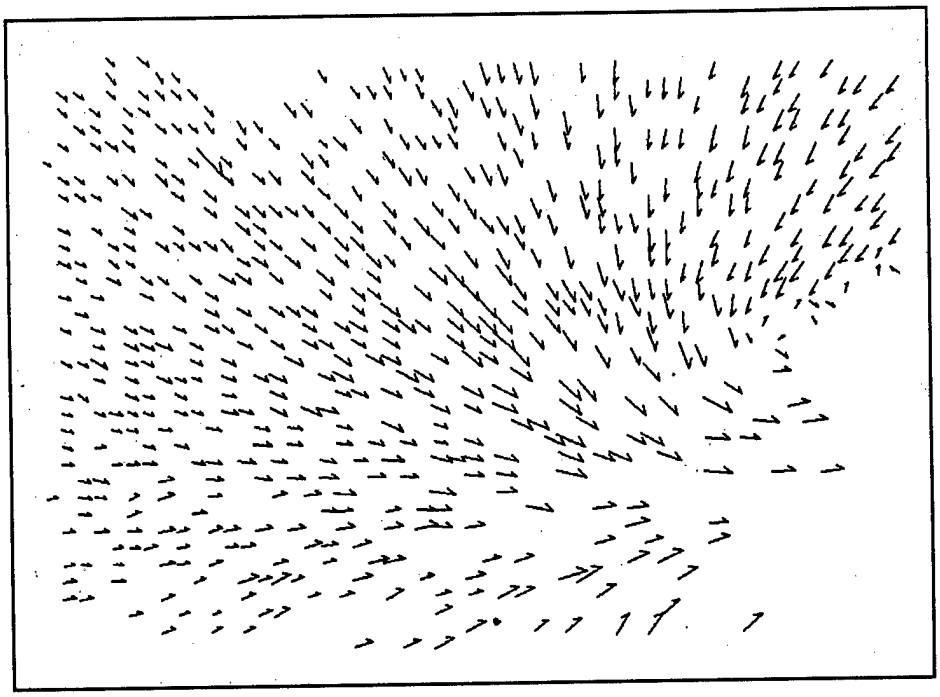


Figure C19 Velocity vector map at x/L=1.15, fully appended configuration, yaw=8, pitch=0 and roll=0.



NO PHOTOGRAPH AVAILABLE

Figure C20 Velocity vector map at x/L=0.75, bare hull configuration, yaw=16, pitch=0 and roll=0.

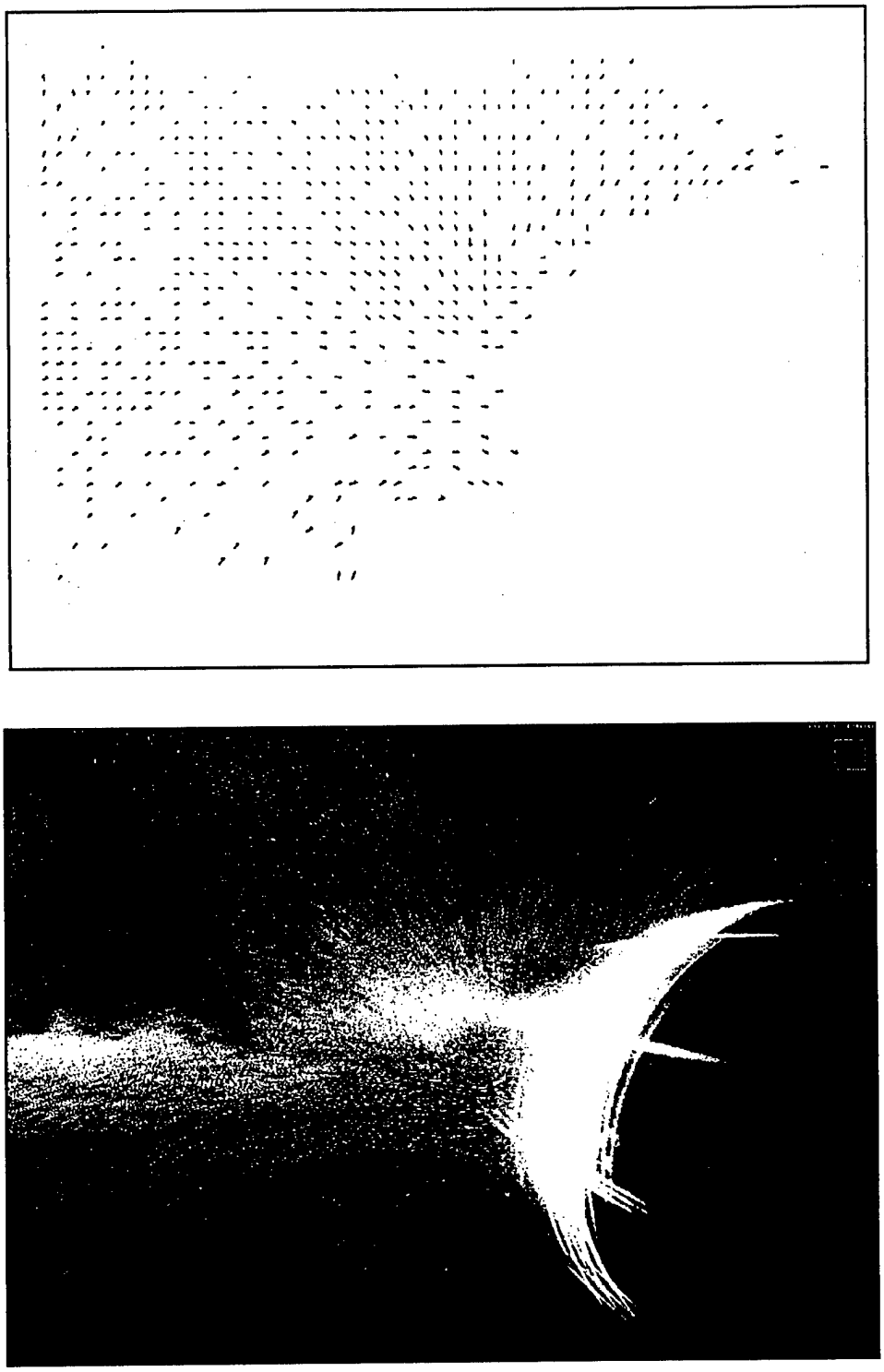


Figure C21 Velocity vector map at x/L=0.75, sail only configuration, yaw=16, pitch=0 and roll=0.

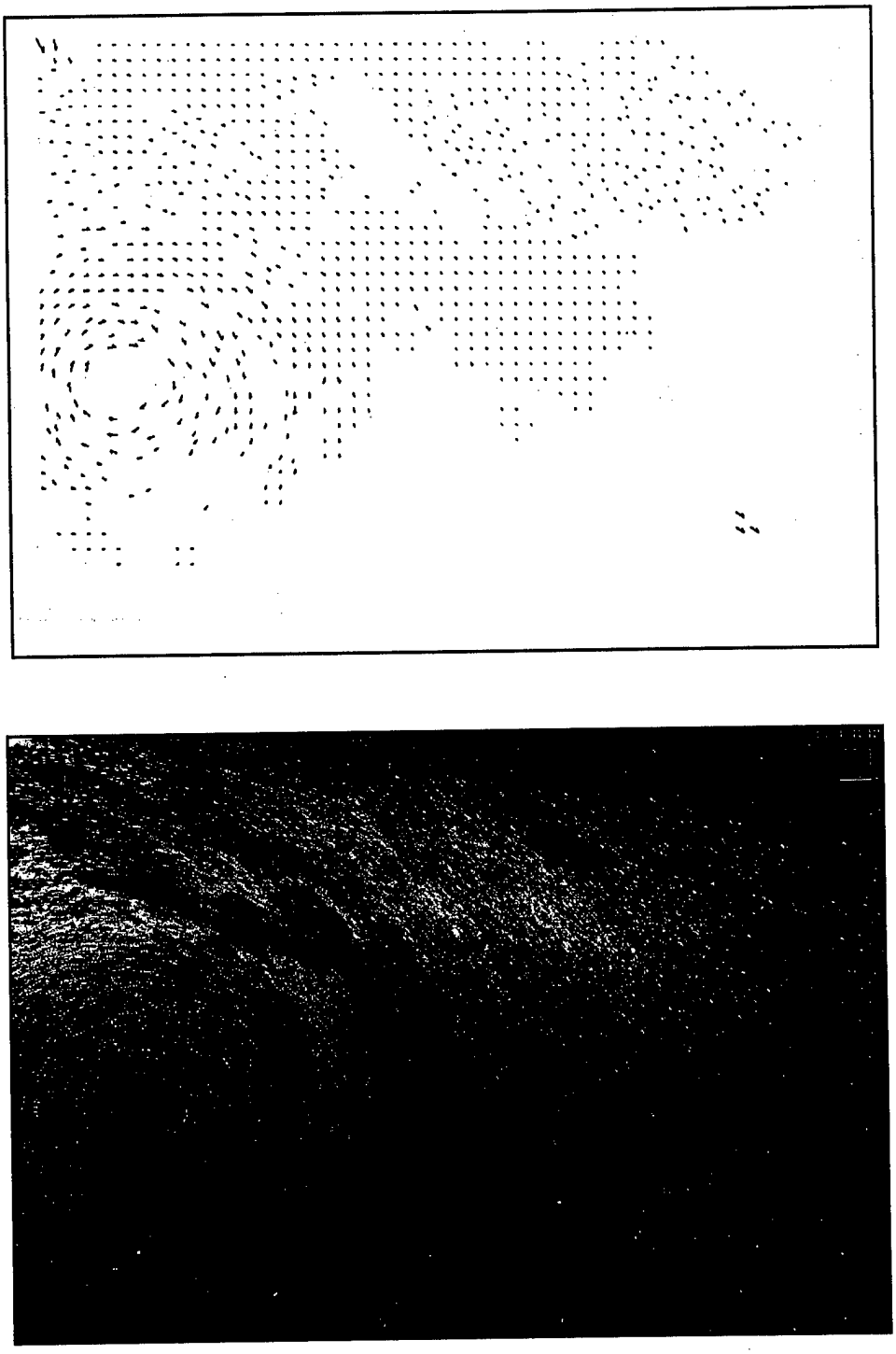


Figure C22 Velocity vector map at x/L=1.25, sail only configuration, yaw=16, pitch=0 and roll=0.

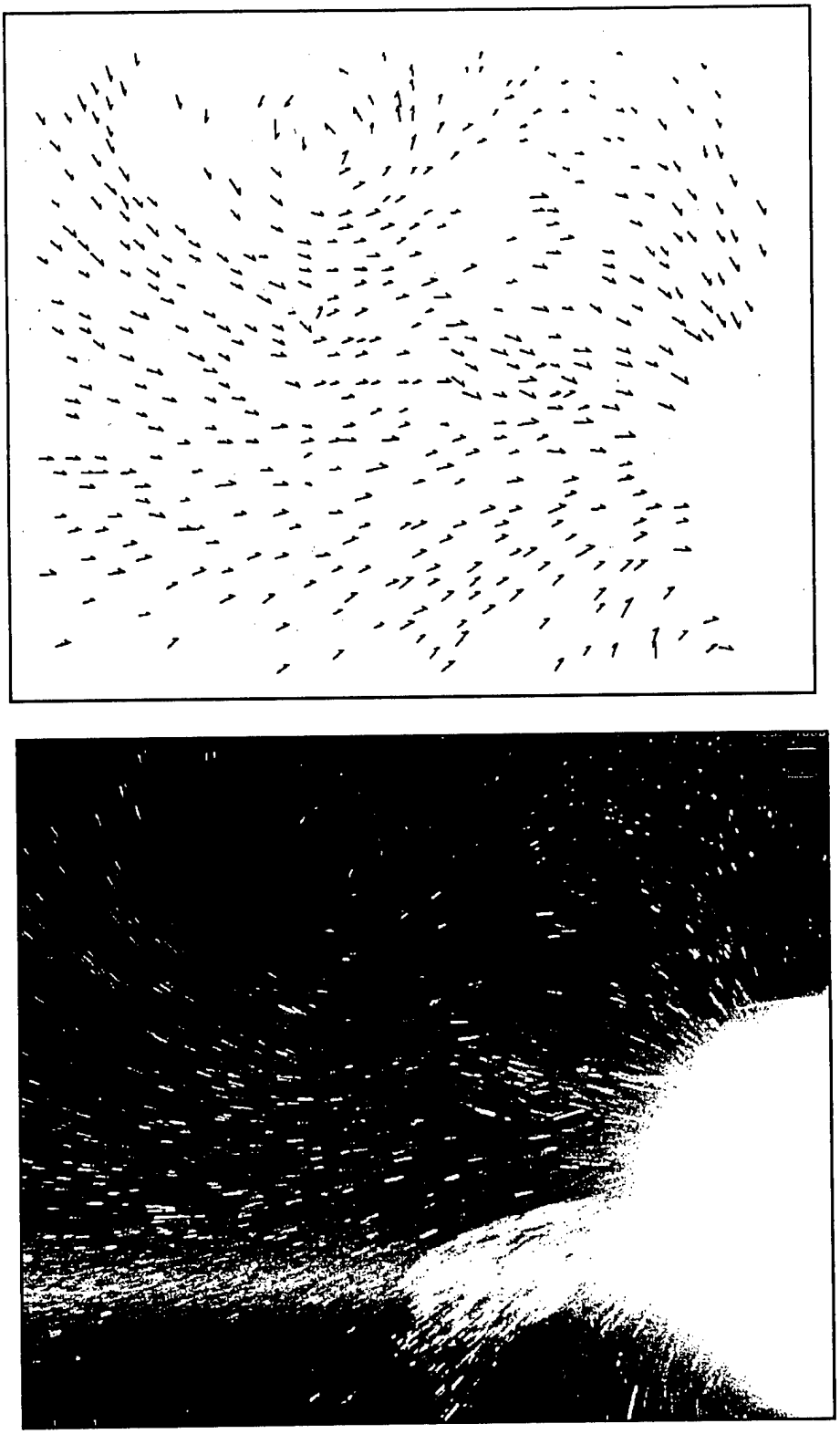


Figure C23 Velocity vector map at x/L=0.65, fully appended configuration, yaw=16, pitch=0 and roll=0.

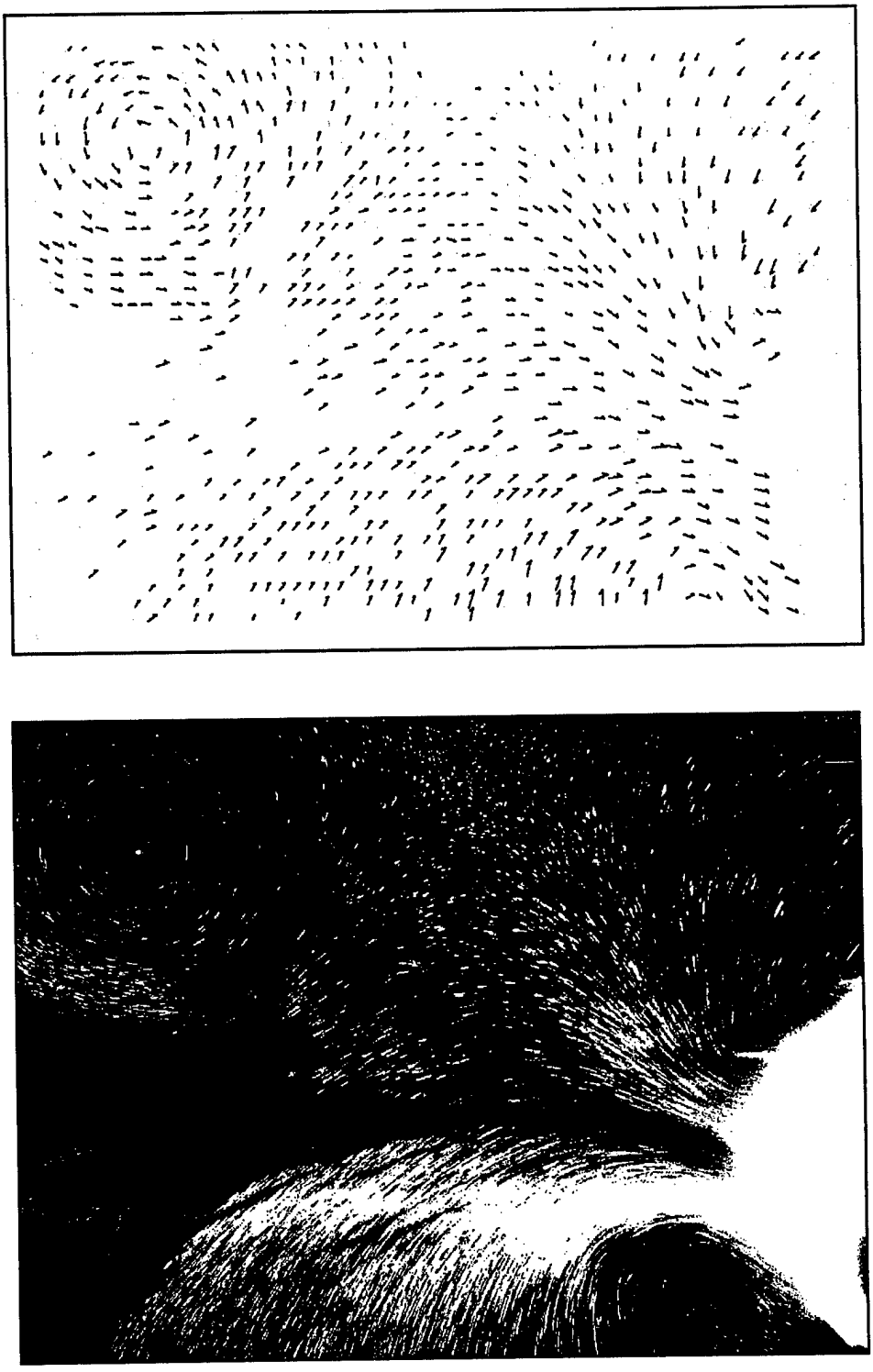


Figure C24 Velocity vector map at x/L=0.75, fully appended configuration, yaw=16, pitch=0 and roll=0.

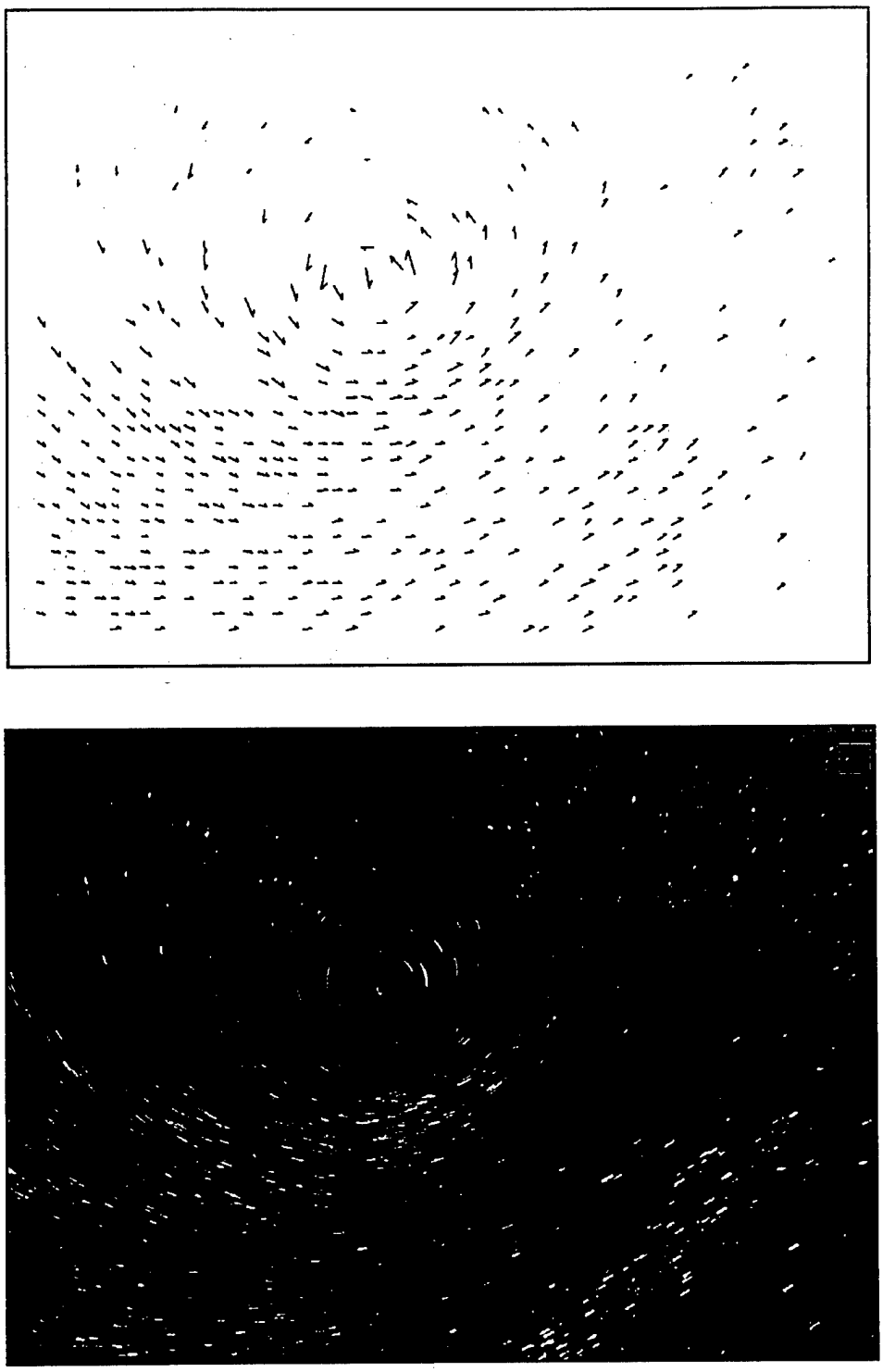


Figure C25 Velocity vector map at x/L=1.15, fully appended configuration, yaw=16, pitch=0 and roll=0.

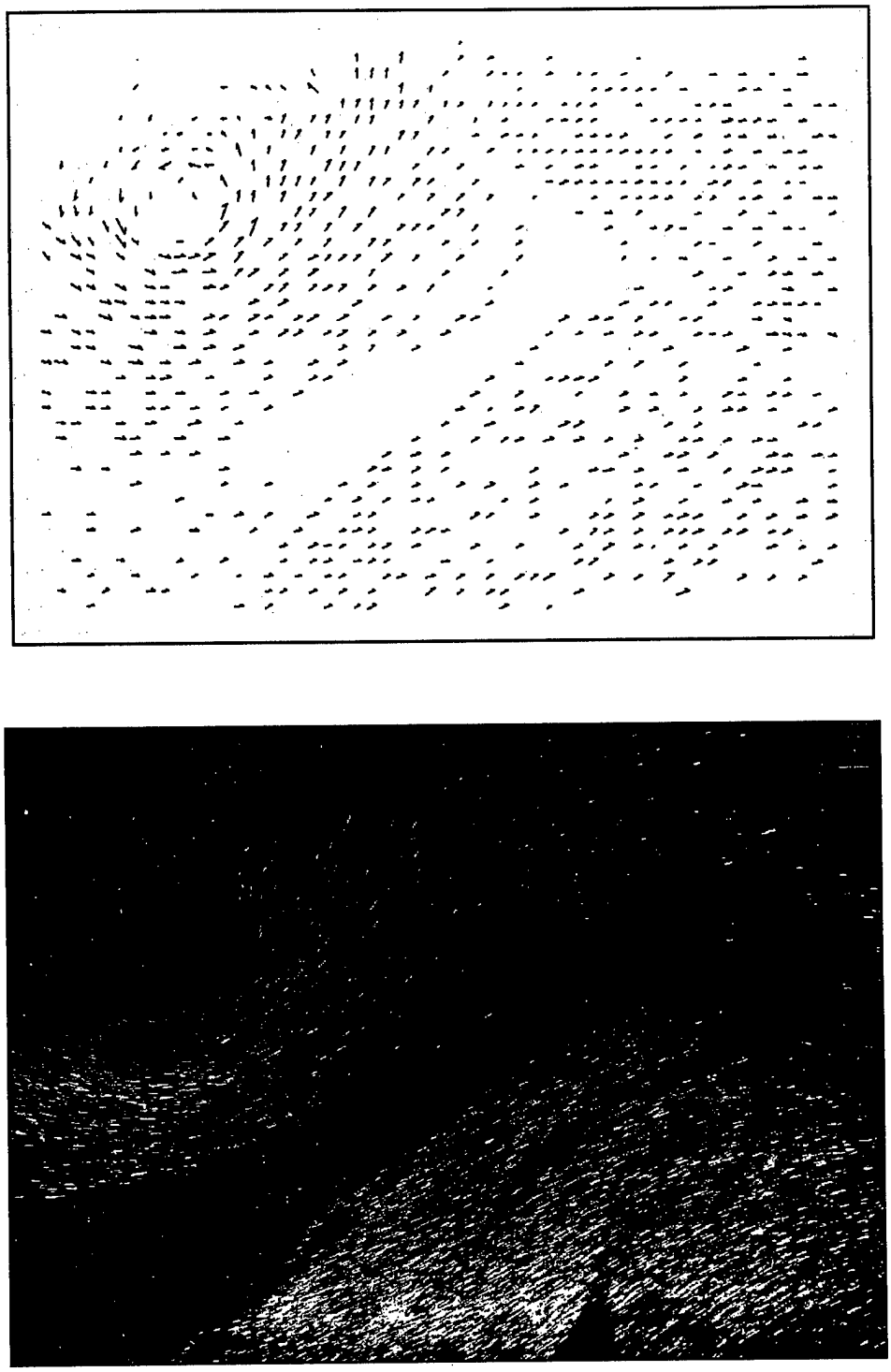


Figure C26 Velocity vector map at x/L=1.25, fully appended configuration, yaw=16, pitch=0 and roll=0.

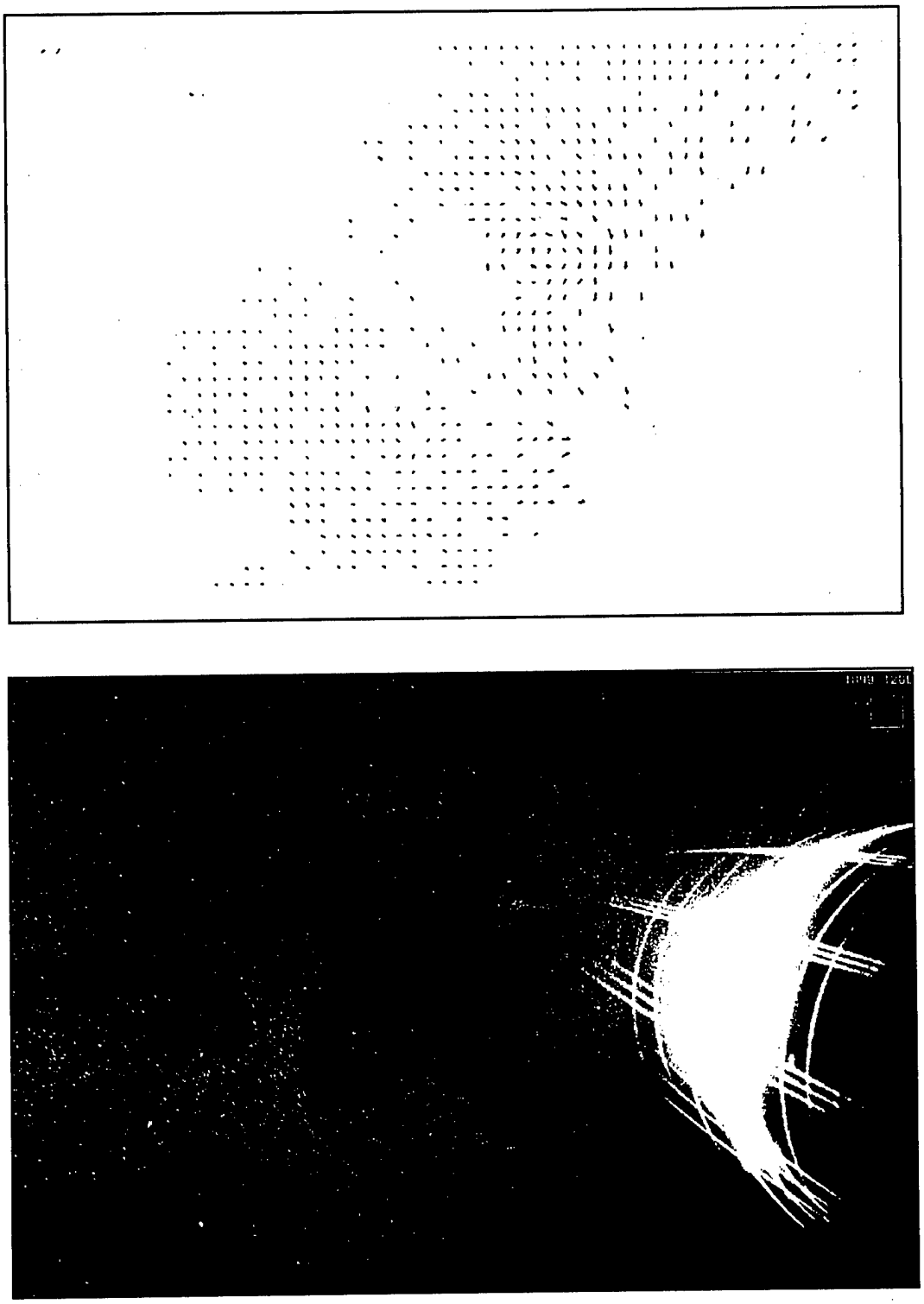


Figure C27 Velocity vector map at x/L=0.65, fully appended configuration, yaw=0, pitch=-8 and roll=0.

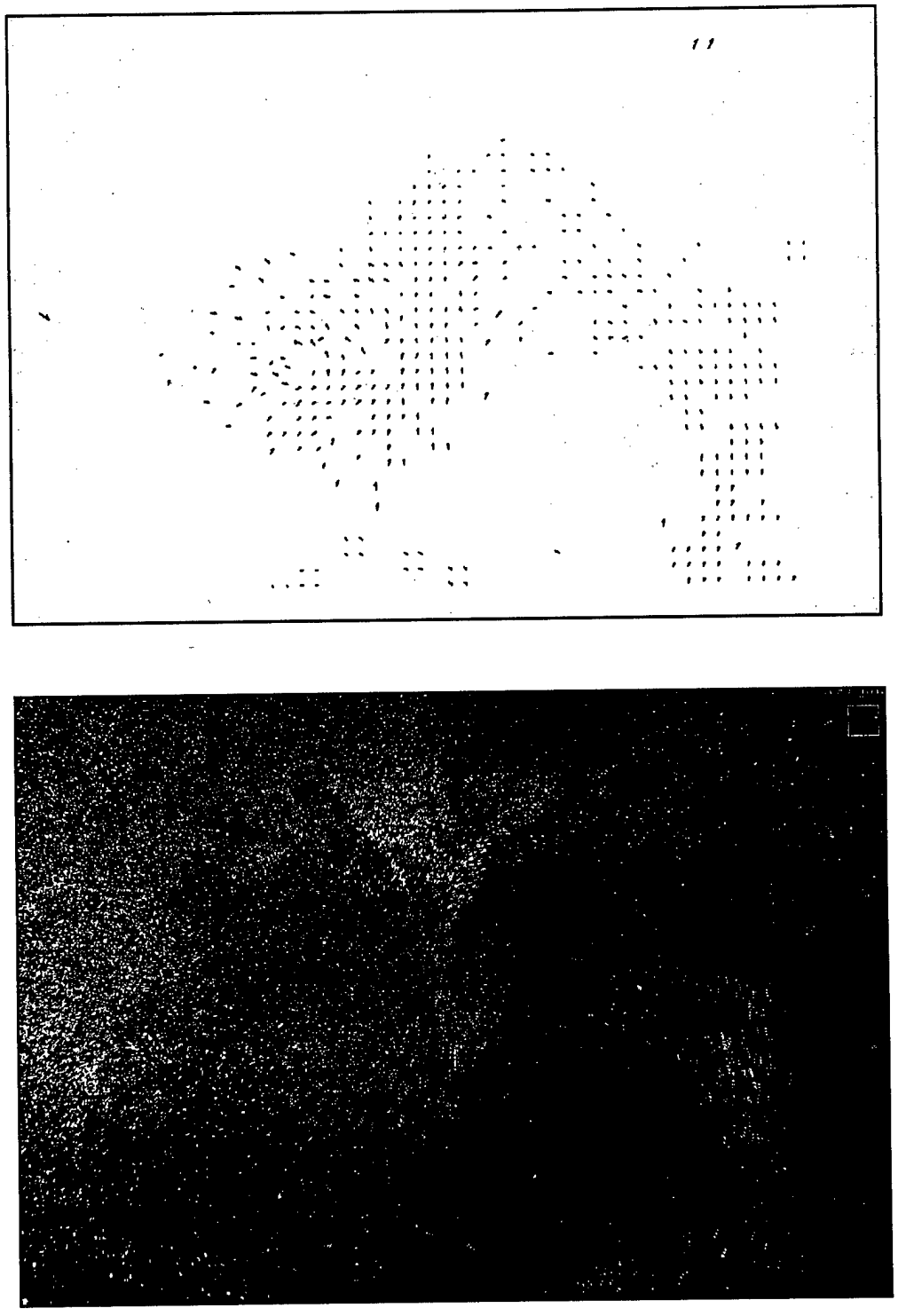
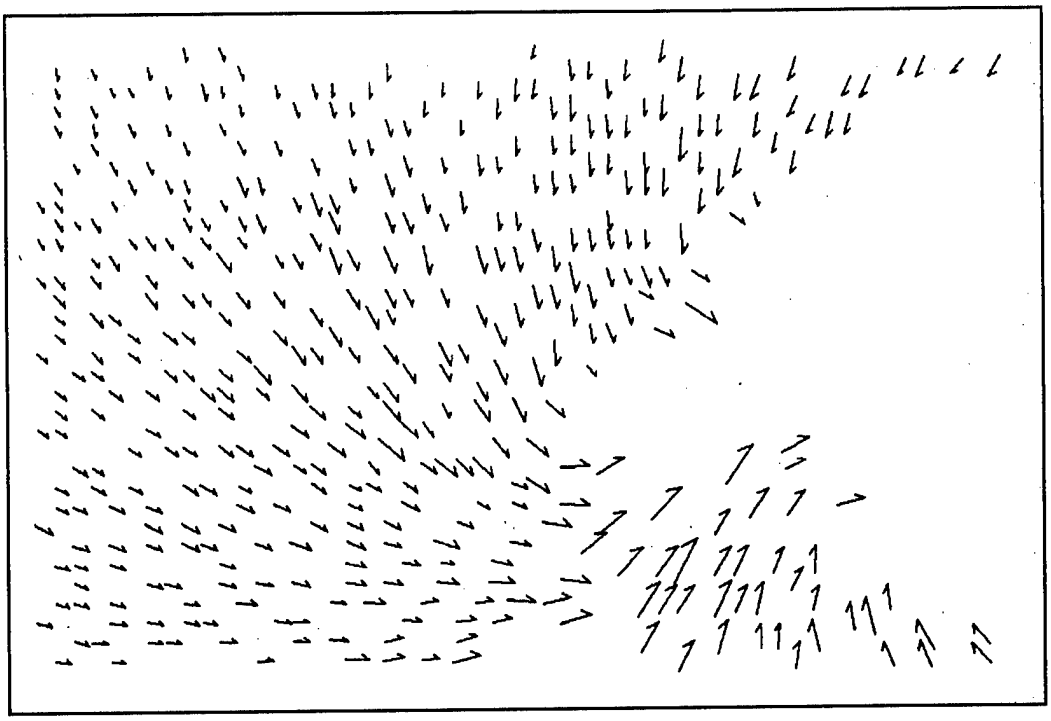


Figure C28 Velocity vector map at x/L=0.75, fully appended configuration, yaw=0, pitch=-8 and roll=0.



NO PHOTOGRAPH AVAILABLE

Figure C29 Velocity vector map at x/L=0.75, bare hull configuration, yaw=8, pitch=-8 and roll=0.

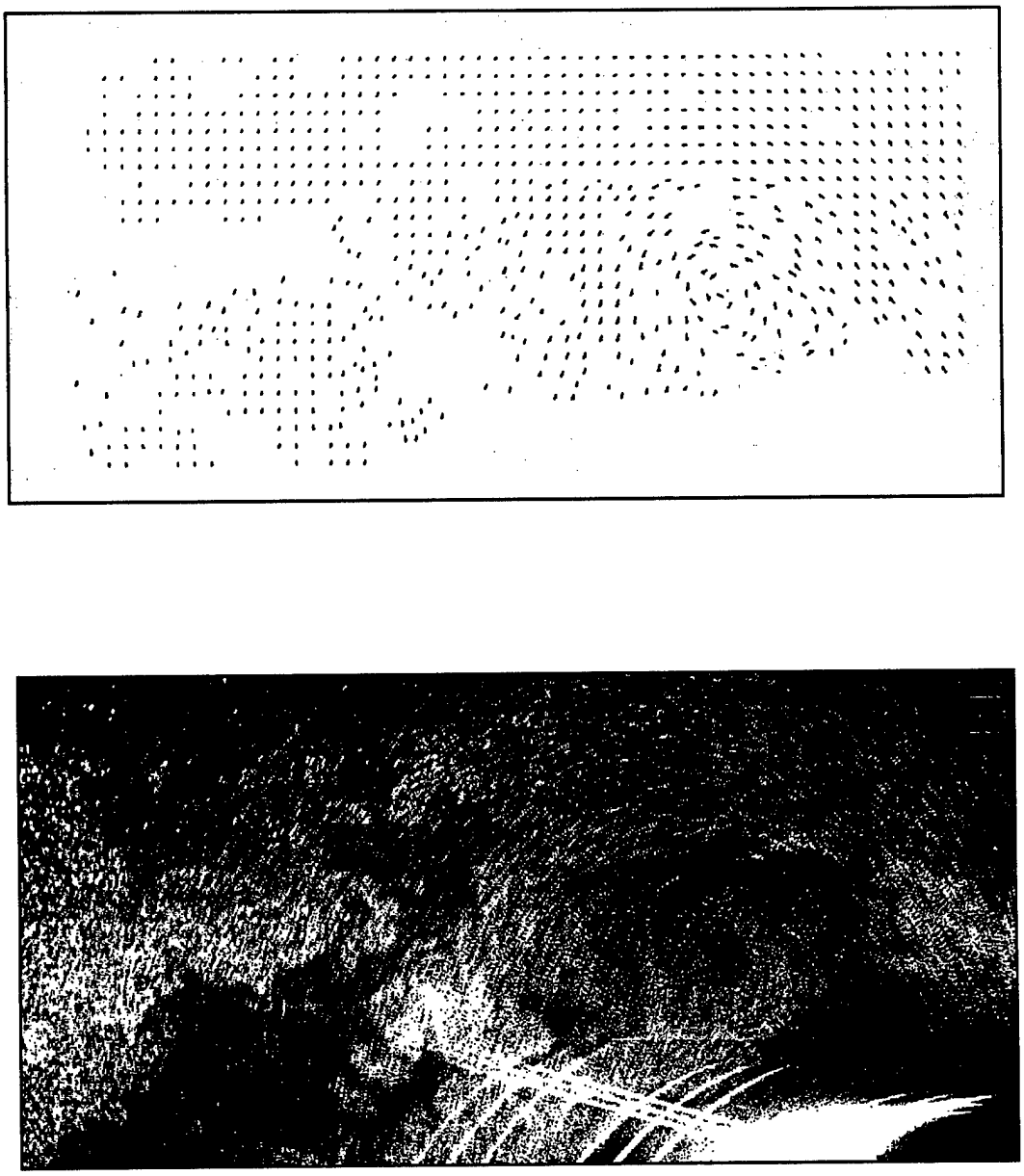


Figure C30 Velocity vector map at x/L=0.45, sail only configuration, yaw=8, pitch=-8 and roll=0.

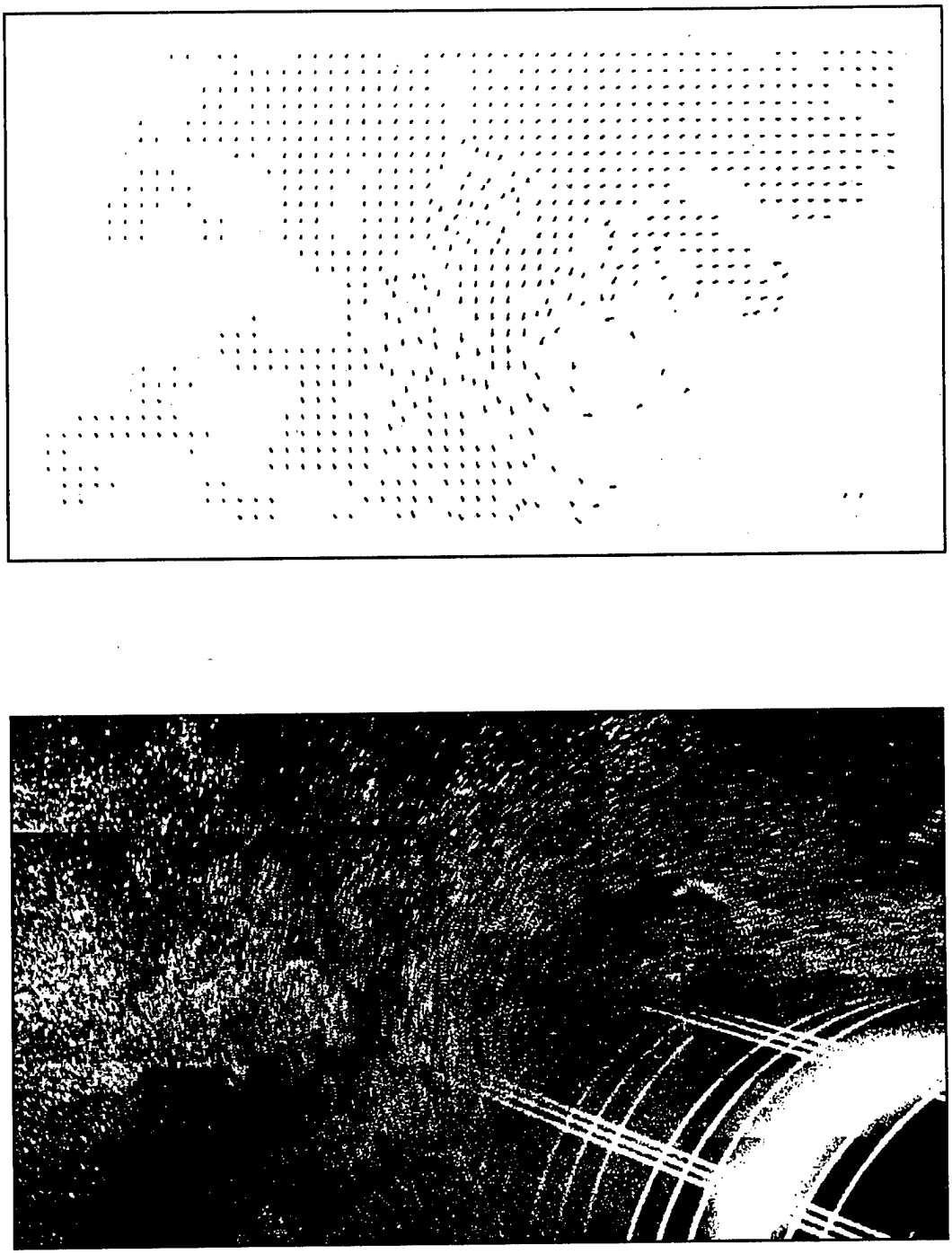


Figure C31 Velocity vector map at x/L=0.55, sail only configuration, yaw=8, pitch=-8 and roll=0.

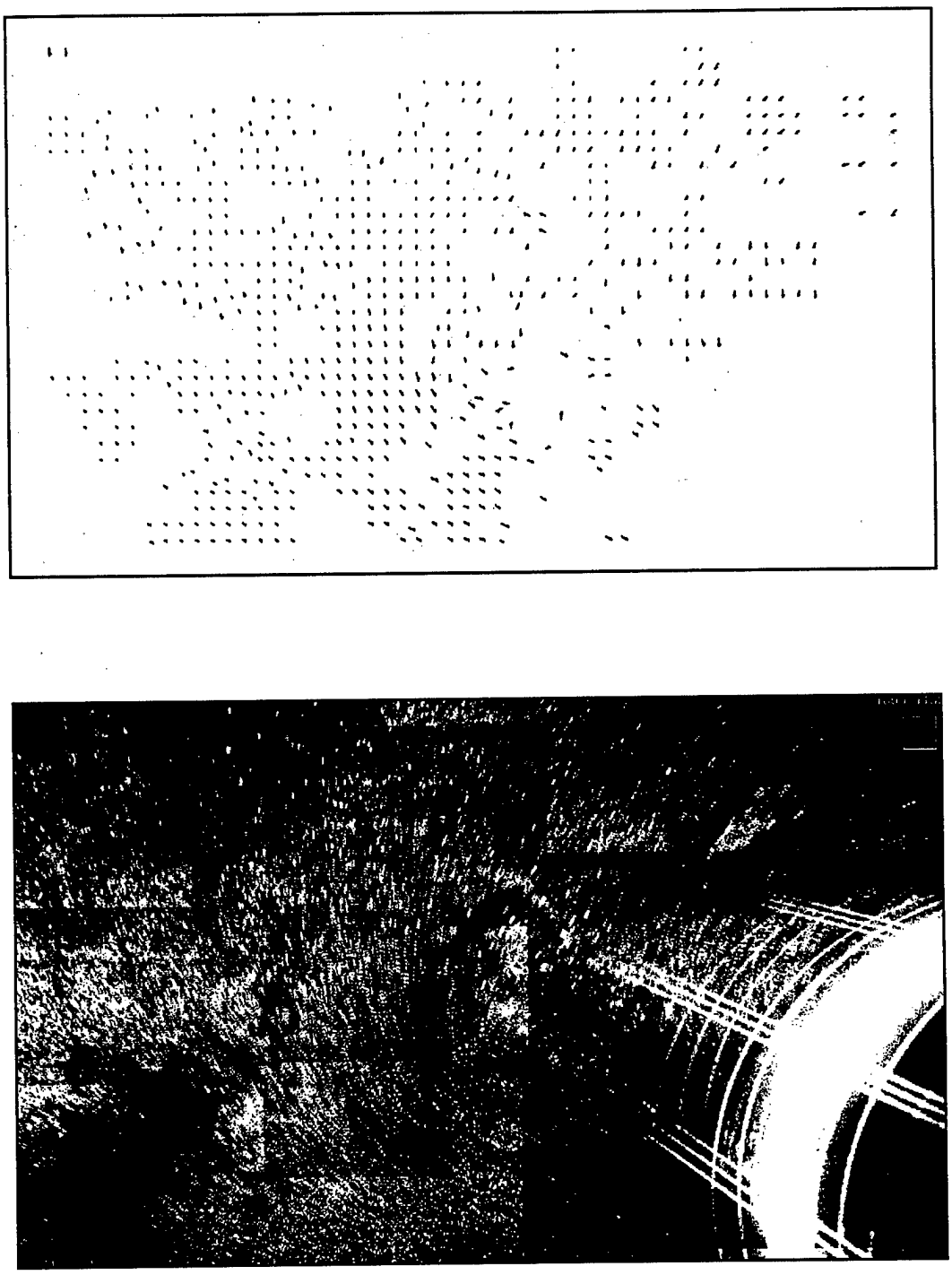


Figure C32 Velocity vector map at x/L=0.65, sail only configuration, yaw=8, pitch=-8 and roll=0.

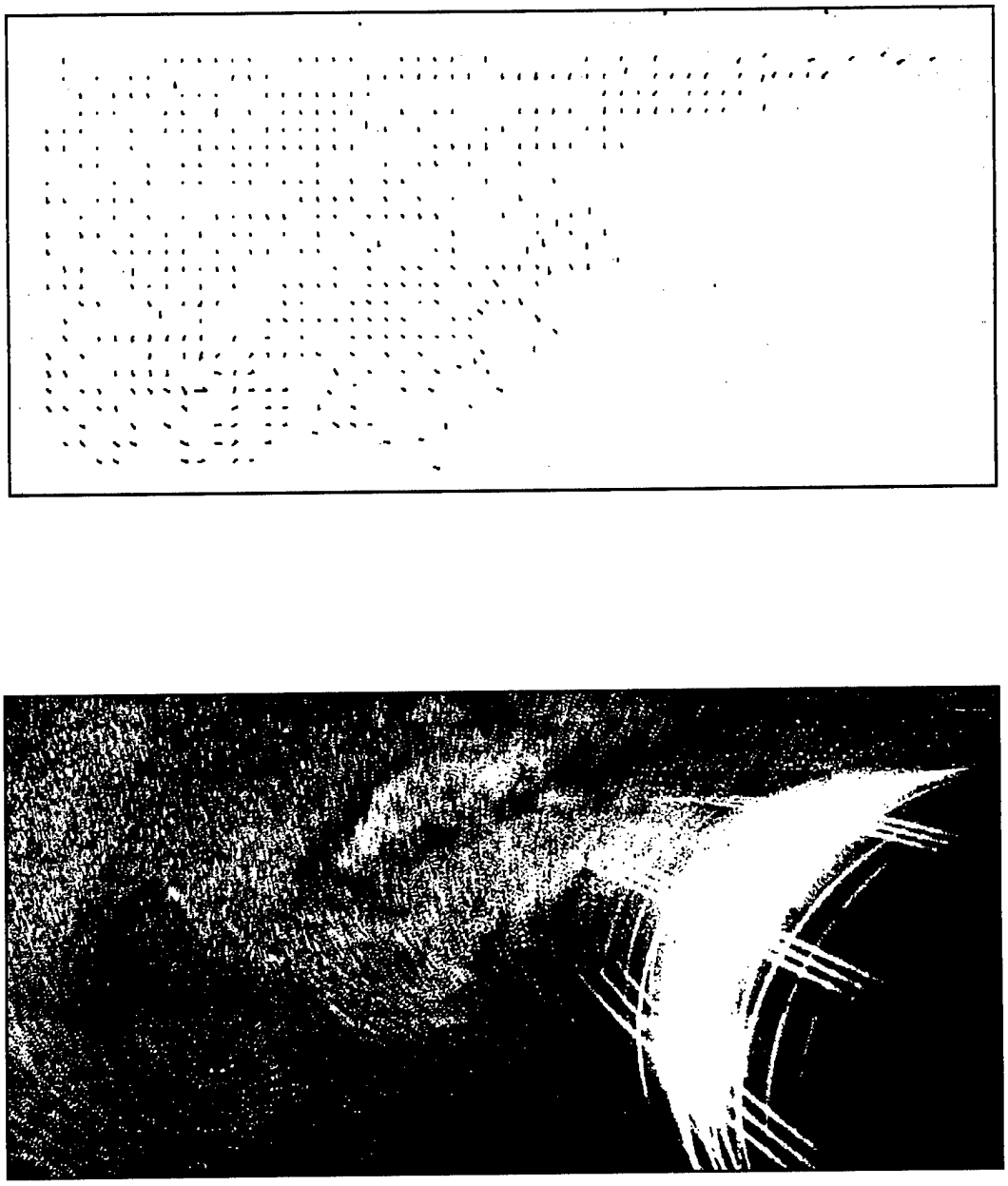


Figure C33 Velocity vector map at x/L=0.75, sail only configuration, yaw=8, pitch=-8 and roll=0.

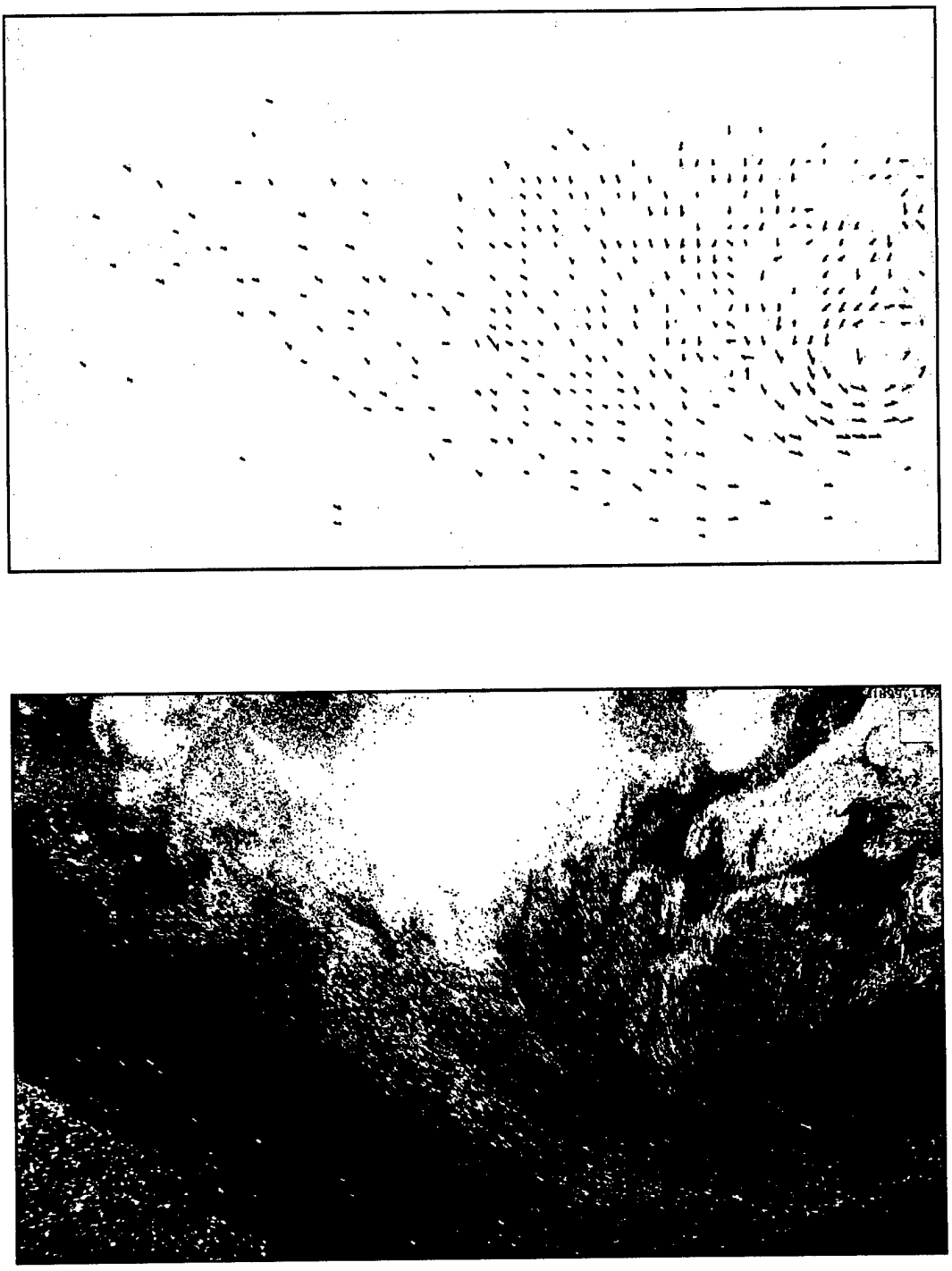


Figure C34 Velocity vector map at x/L=1.05, sail only configuration, yaw=8, pitch=-8 and roll=0.

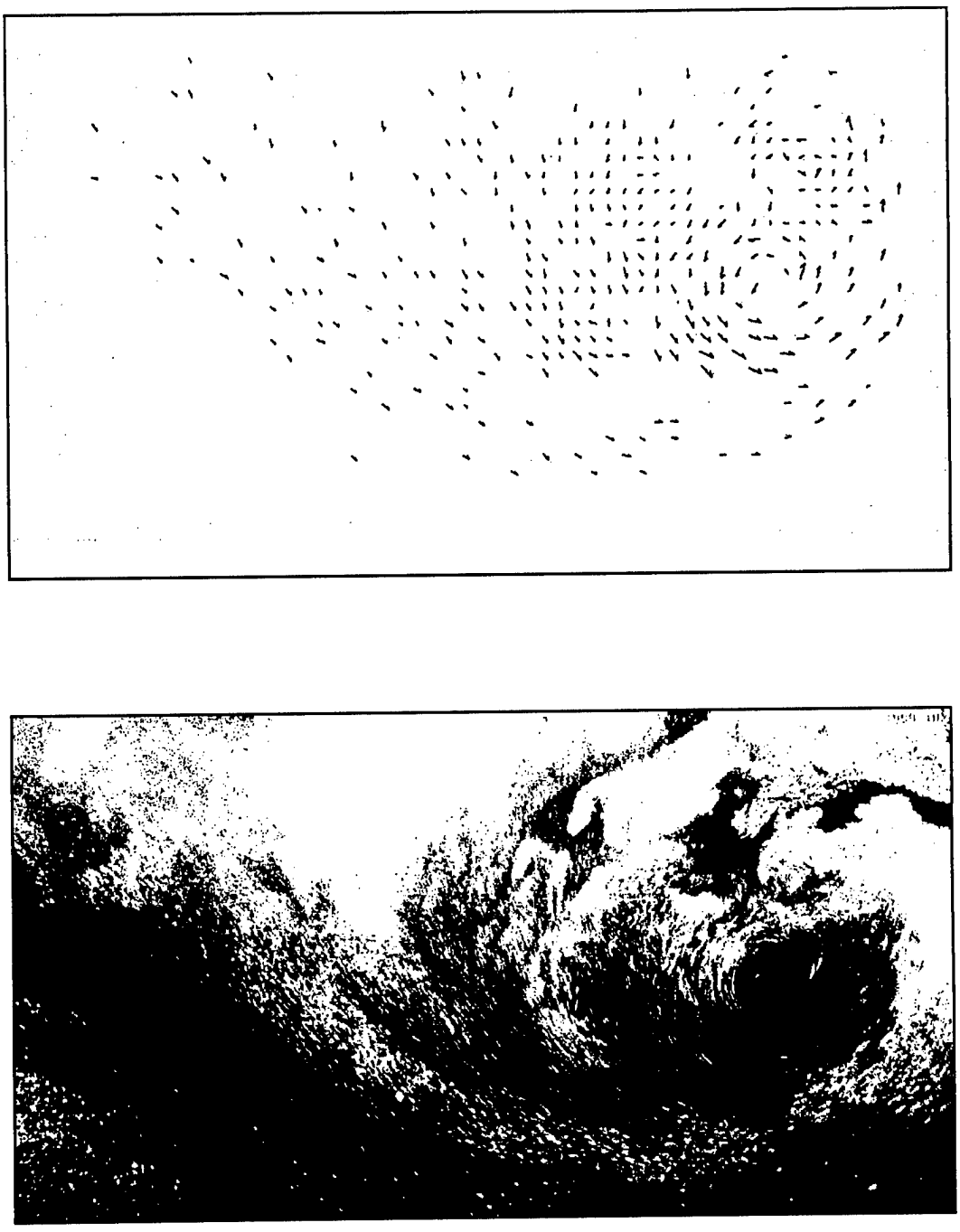


Figure C35 Velocity vector map at x/L=1.15, sail only configuration, yaw=8, pitch=-8 and roll=0.

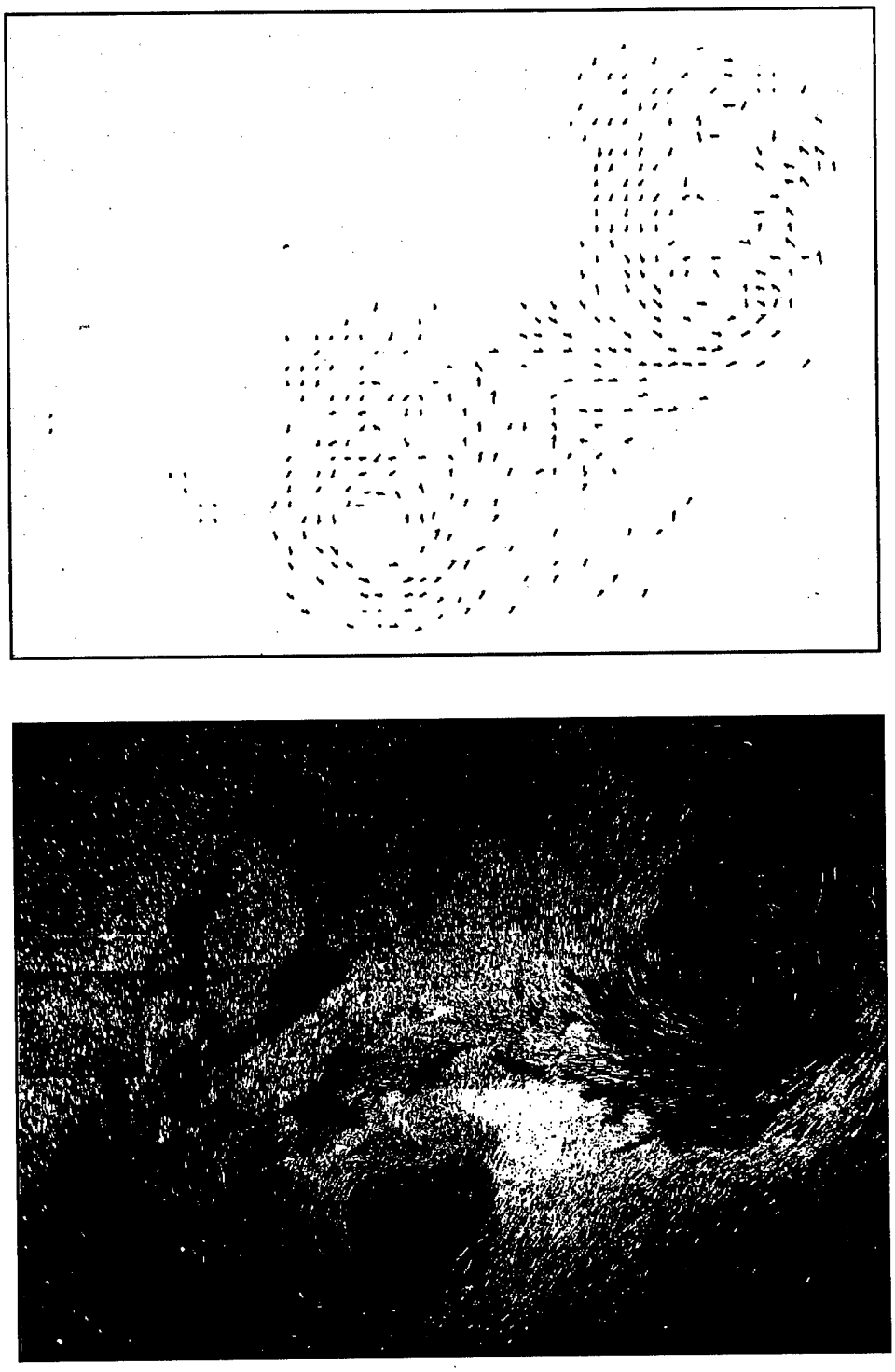


Figure C36 Velocity vector map at x/L=1.25, sail only configuration, yaw=8, pitch=-8 and roll=0.

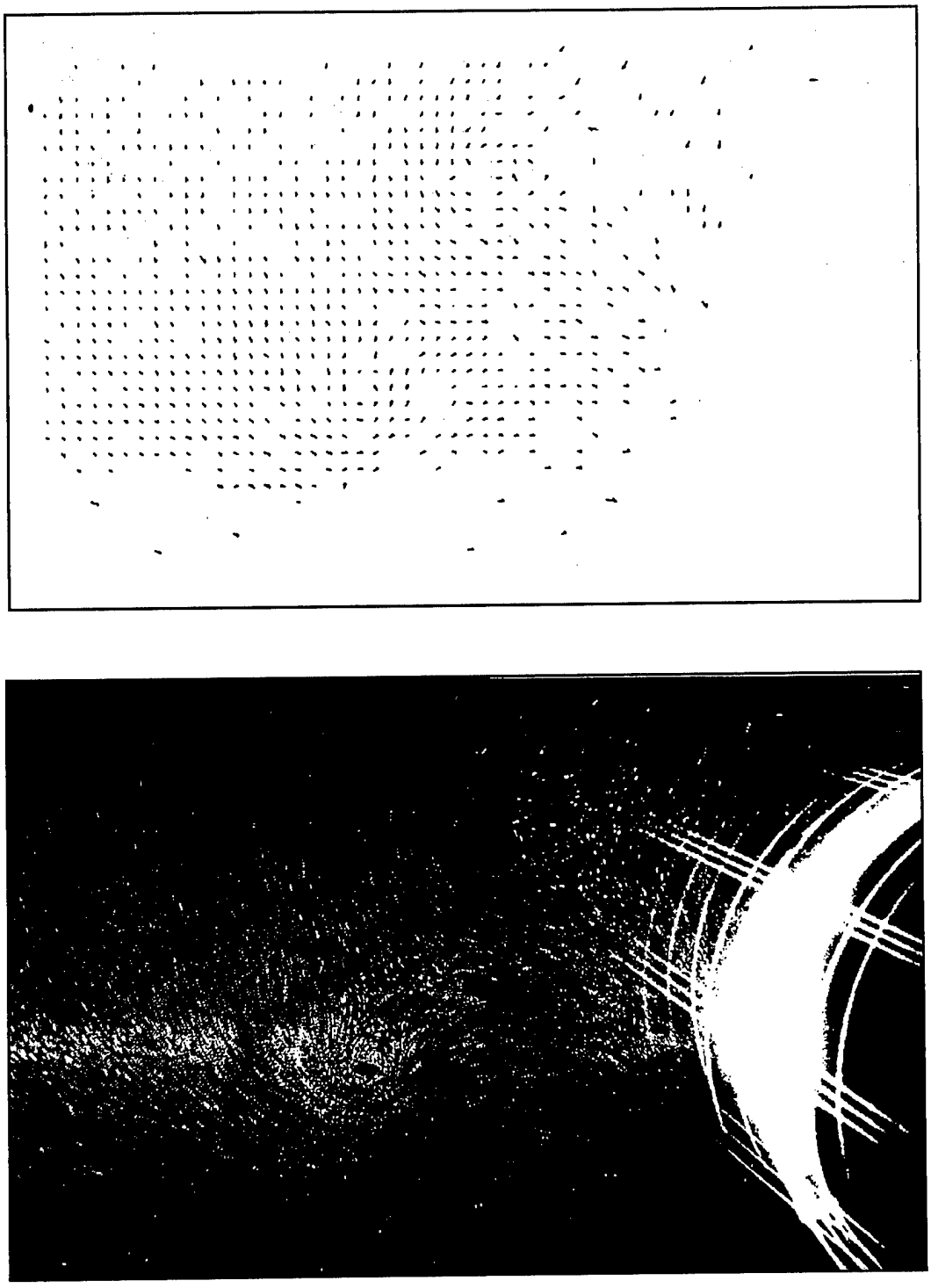


Figure C37 Velocity vector map at x/L=0.65, fully appended configuration, yaw=8, pitch=-8 and roll=0.

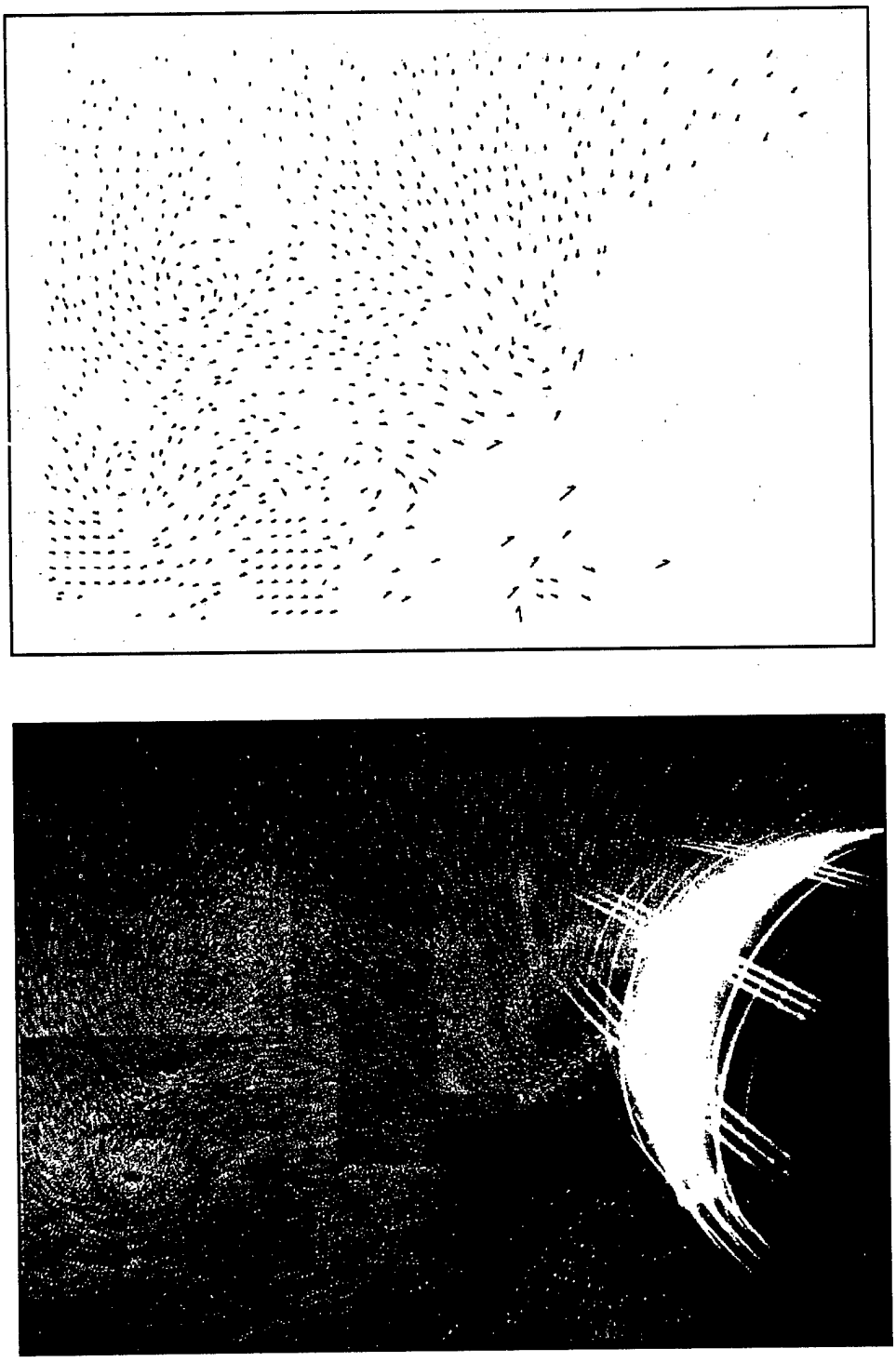


Figure C38 Velocity vector map at x/L=0.75, fully appended configuration, yaw=8, pitch=-8 and roll=0.

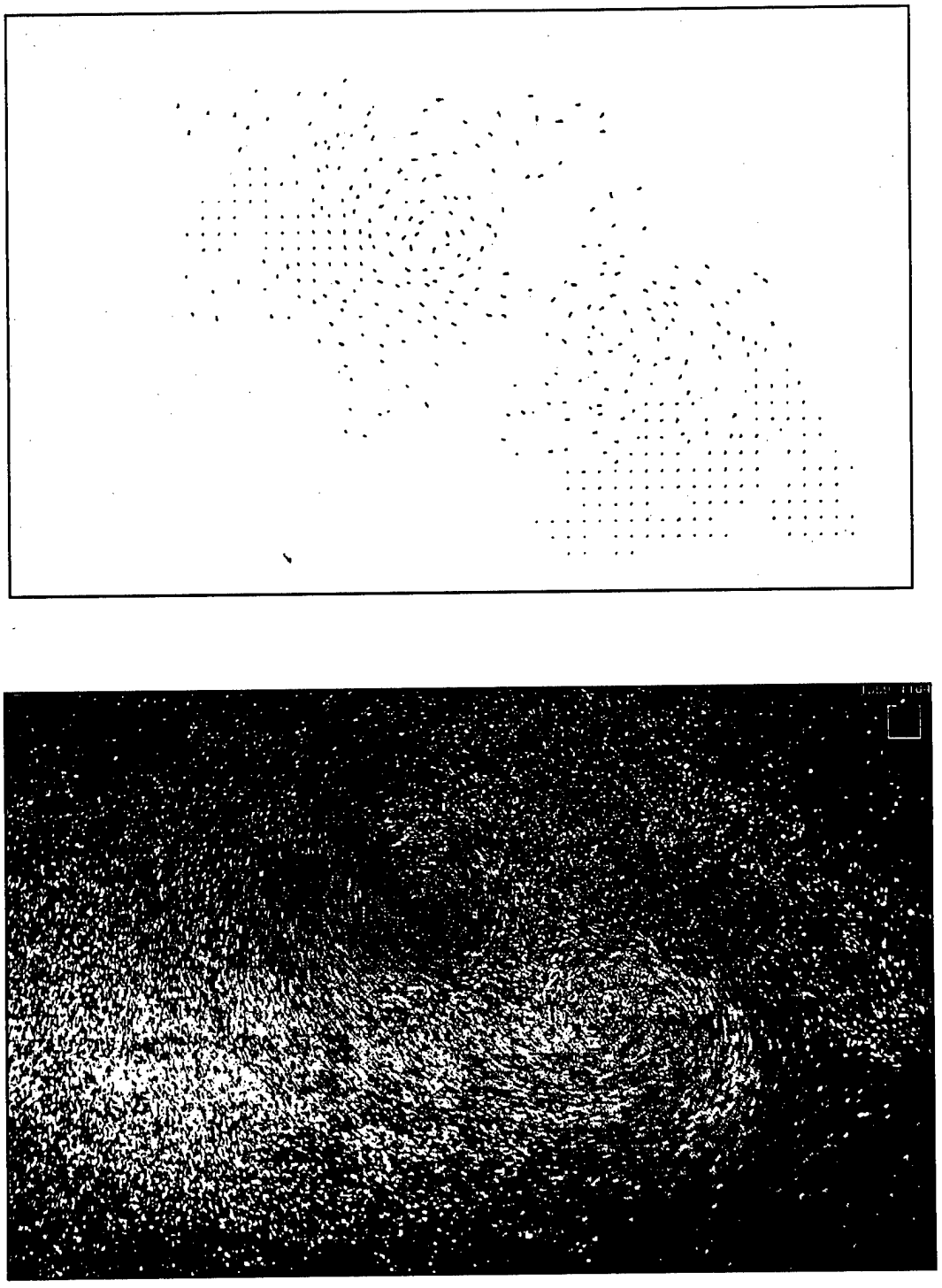


Figure C39 Velocity vector map at x/L=1.15, fully appended configuration, yaw=8, pitch=-8 and roll=0.

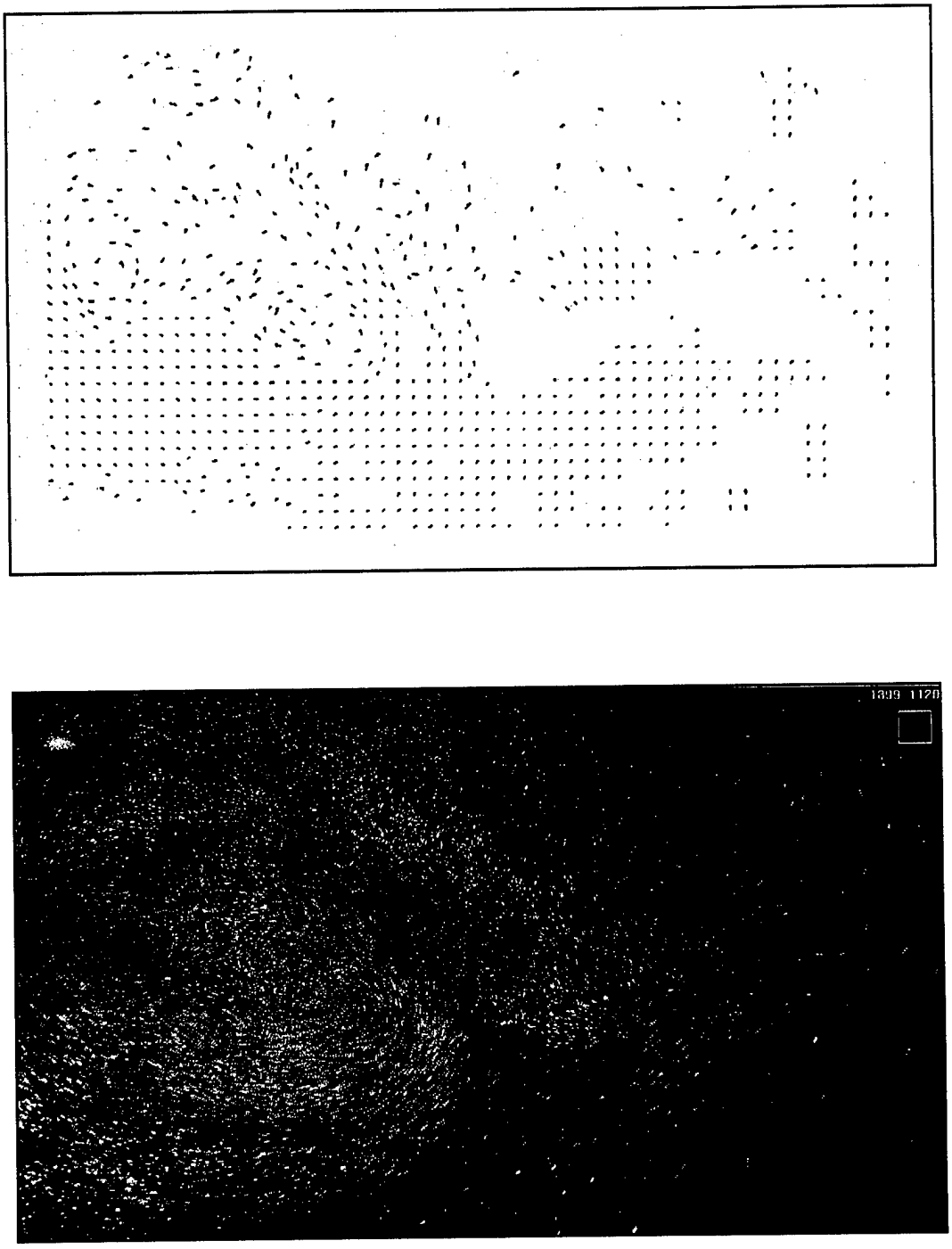


Figure C40 Velocity vector map at x/L=1.25, fully appended configuration, yaw=8, pitch=-8 and roll=0.

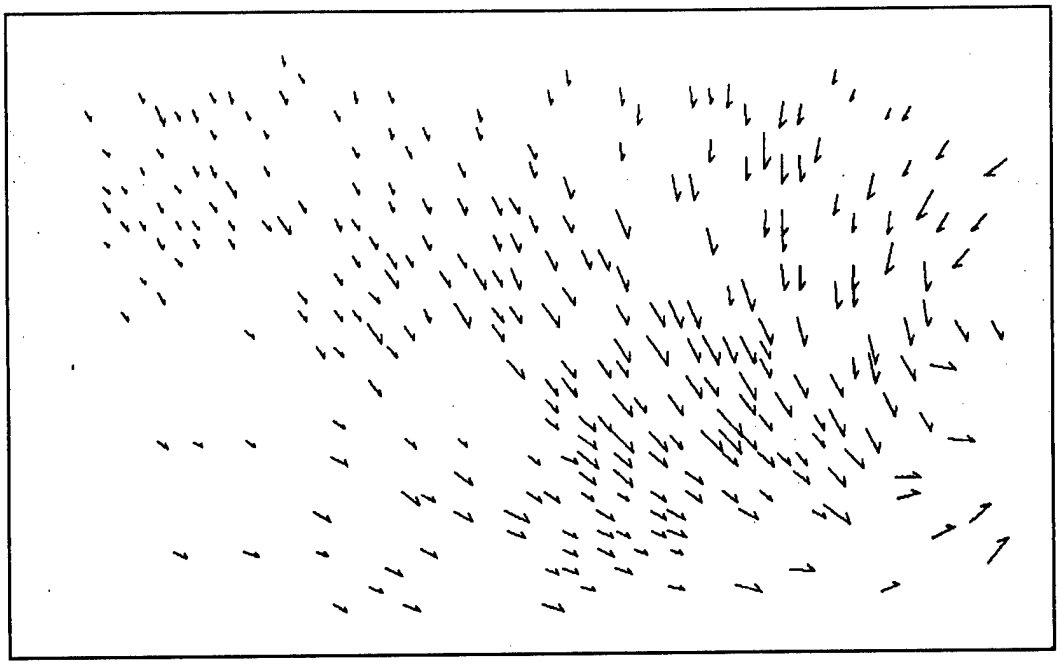


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Figure C41 Velocity vector map at x/L=0.75, bare hull configuration, yaw=16, pitch=-8 and roll=0.

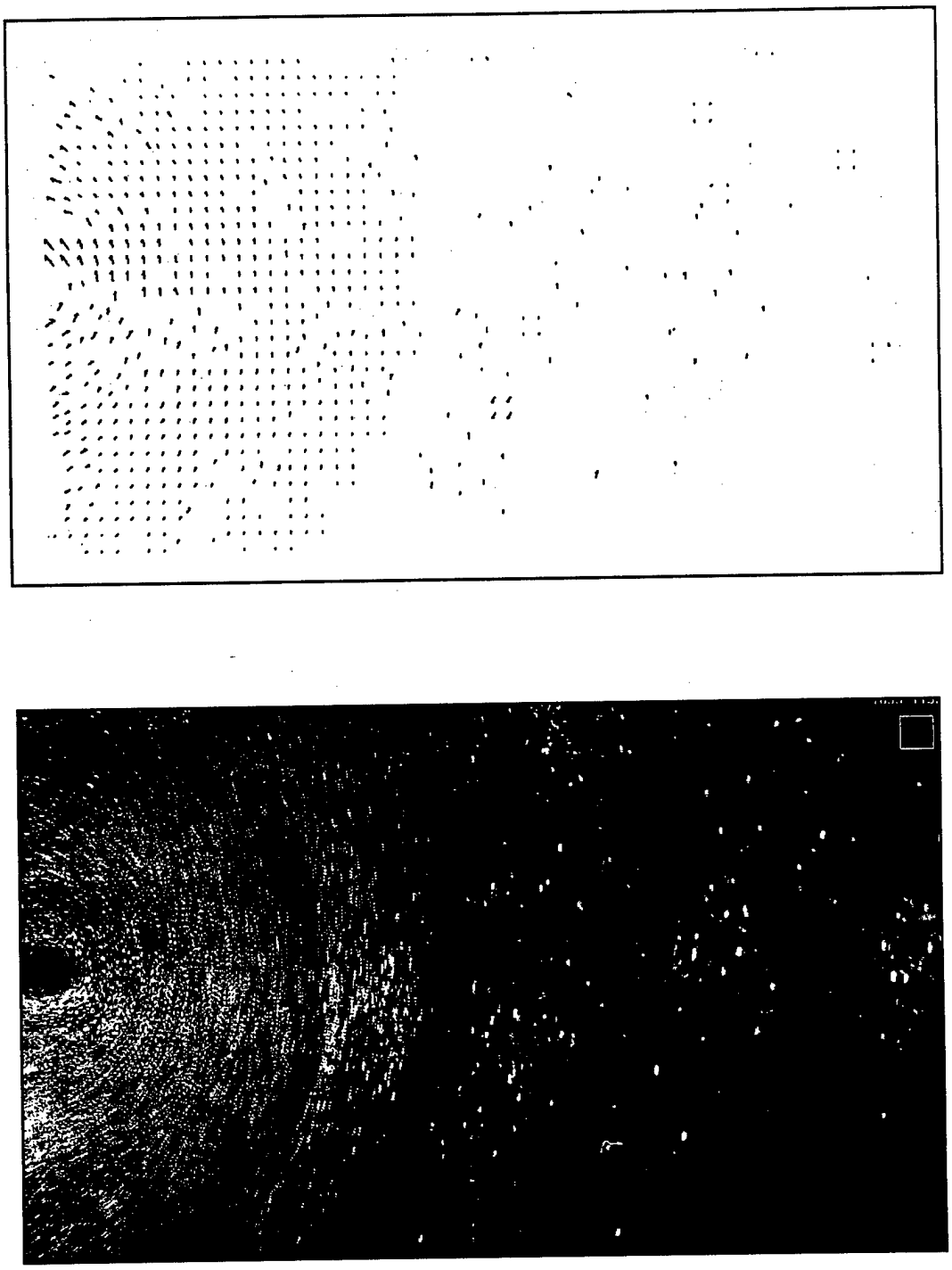
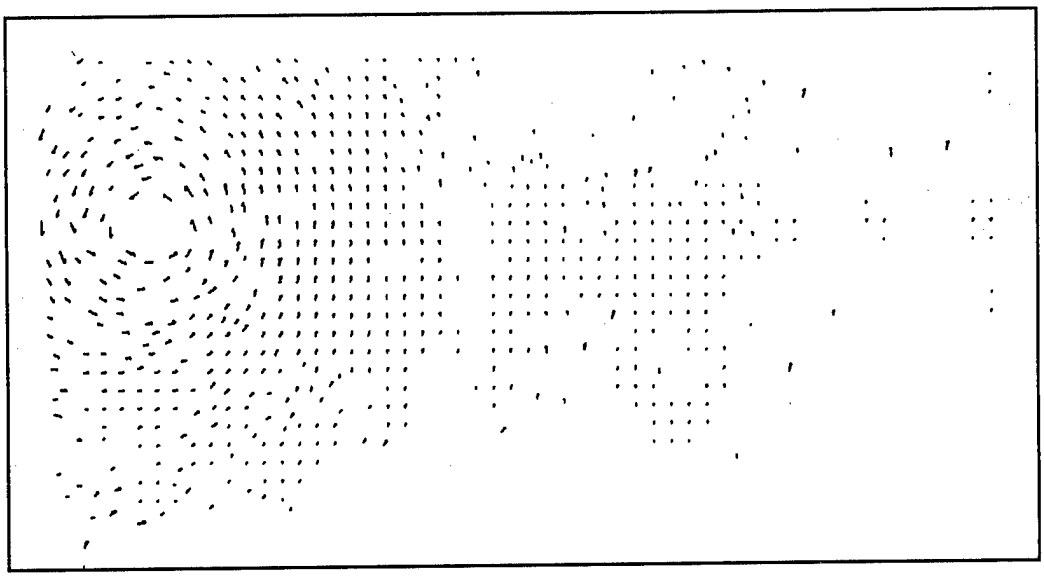


Figure C42 Velocity vector map at x/L=0.45, sail only configuration, yaw=16, pitch=-8 and roll=0.



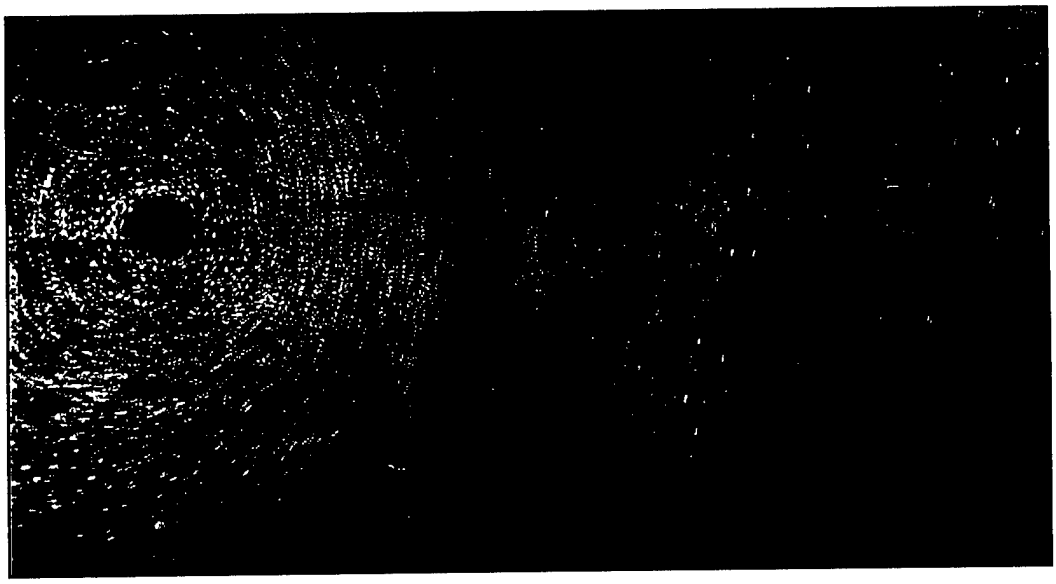


Figure C43 Velocity vector map at x/L=0.55, sail only configuration, yaw=16, pitch=-8 and roll=0.

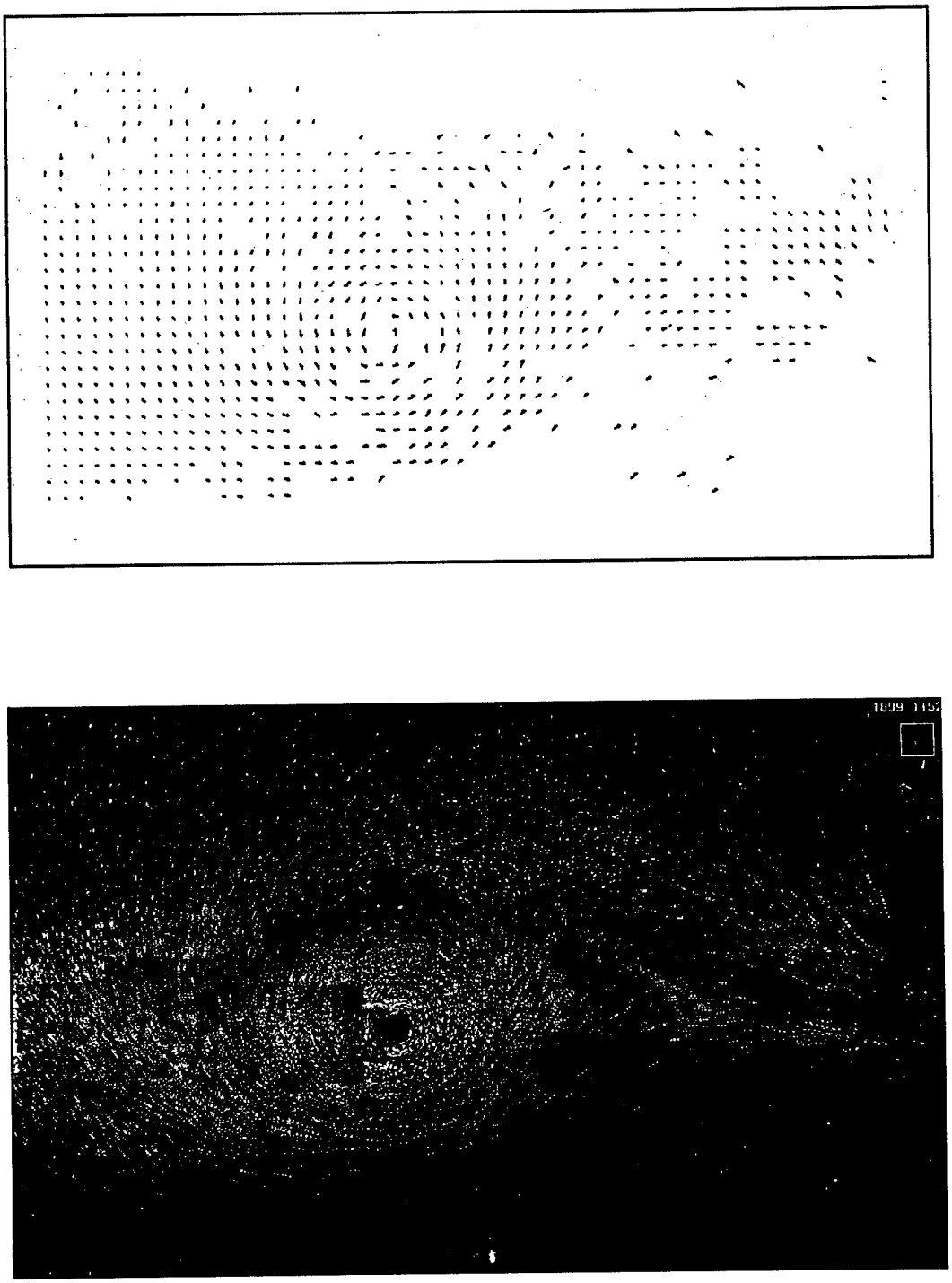


Figure C44 Velocity vector map at x/L=0.75, sail only configuration, yaw=16, pitch=-8 and roll=0.

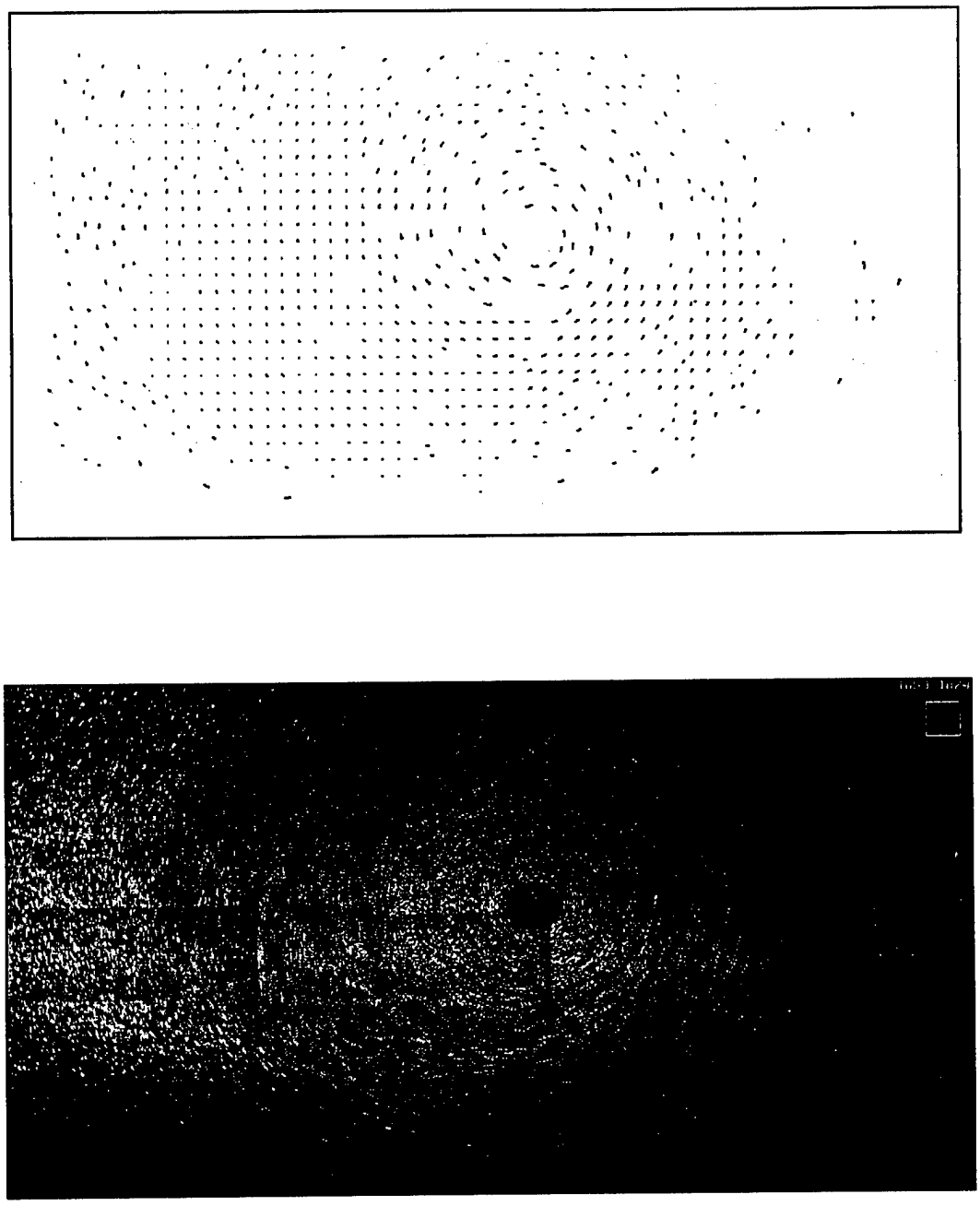


Figure C45 Velocity vector map at x/L=1.25, sail only configuration, yaw=16, pitch=-8 and roll=0.

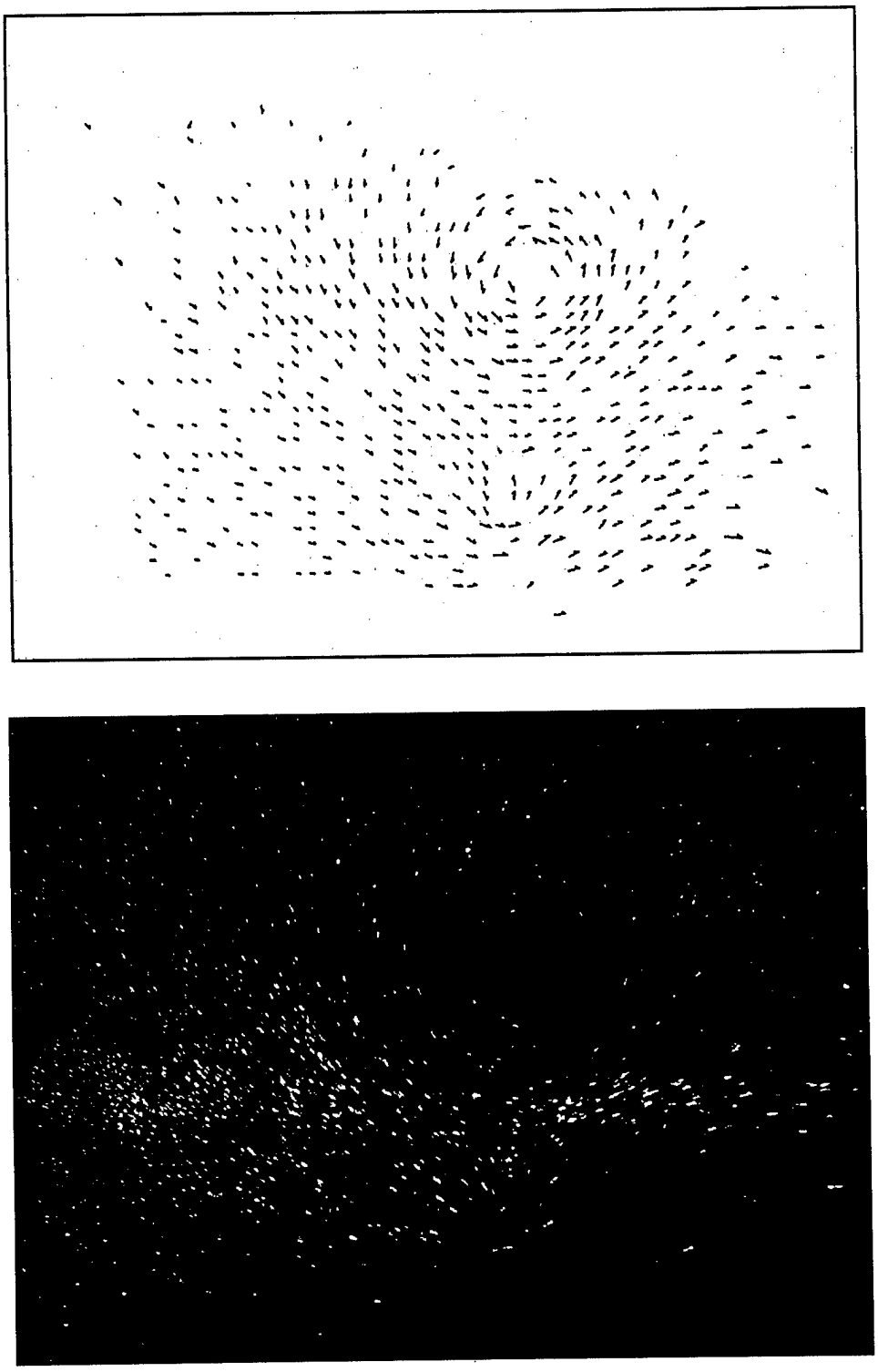


Figure C46 Velocity vector map at x/L=0.65, fully appended configuration, yaw=16, pitch=-8 and roll=0.

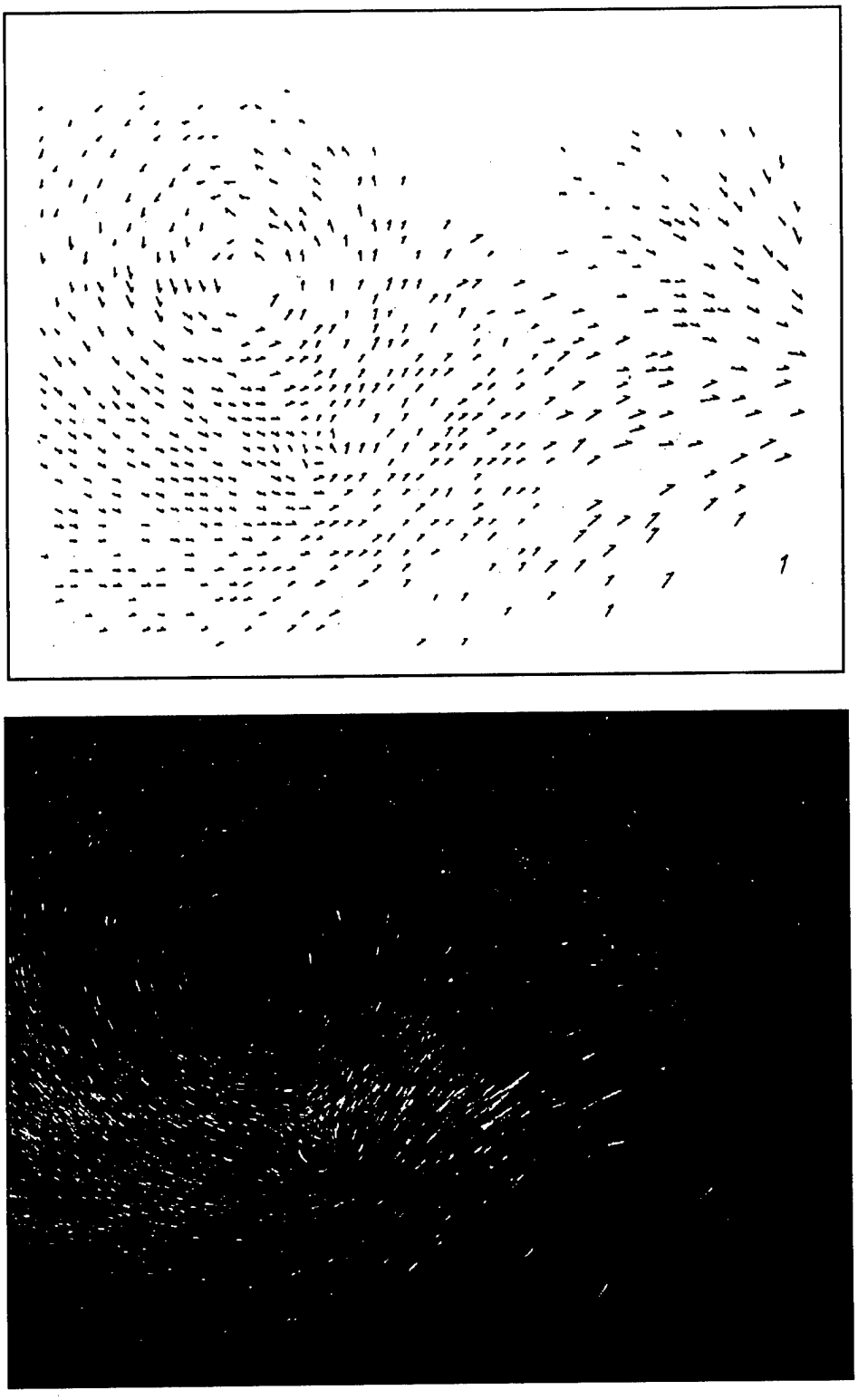


Figure C47 Velocity vector map at x/L=0.75, fully appended configuration, yaw=16, pitch=-8 and roll=0.

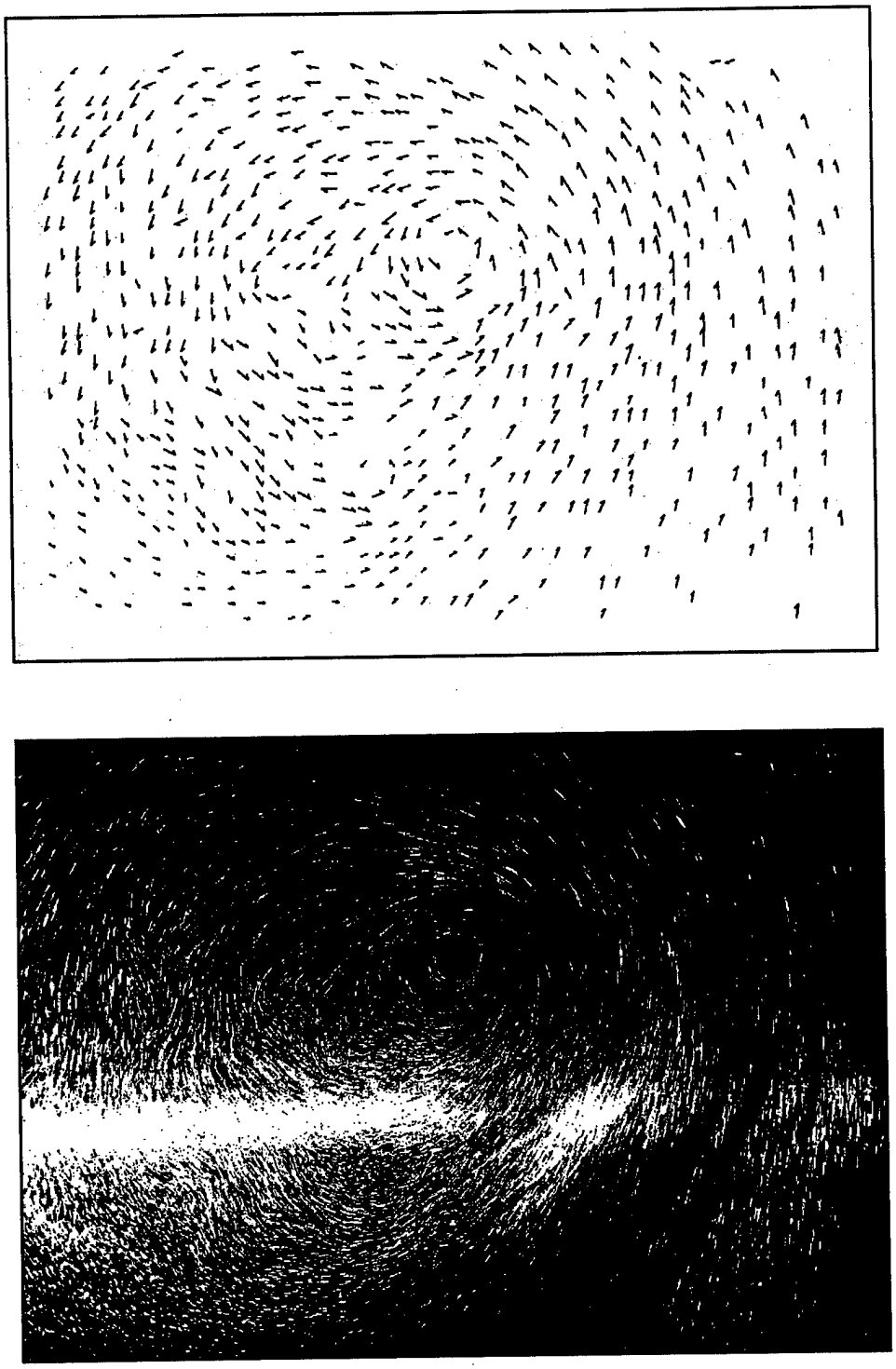


Figure C48 Velocity vector map at x/L=1.25, fully appended configuration, yaw=16, pitch=-8 and roll=0.

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APPENDIX D

Tabulated cross flow velocities for various model configurations

Yaw = 16 degrees
Pitch = 0.0 degrees

(Complete table for all cases in Appendix C shown in separate floppy disk)

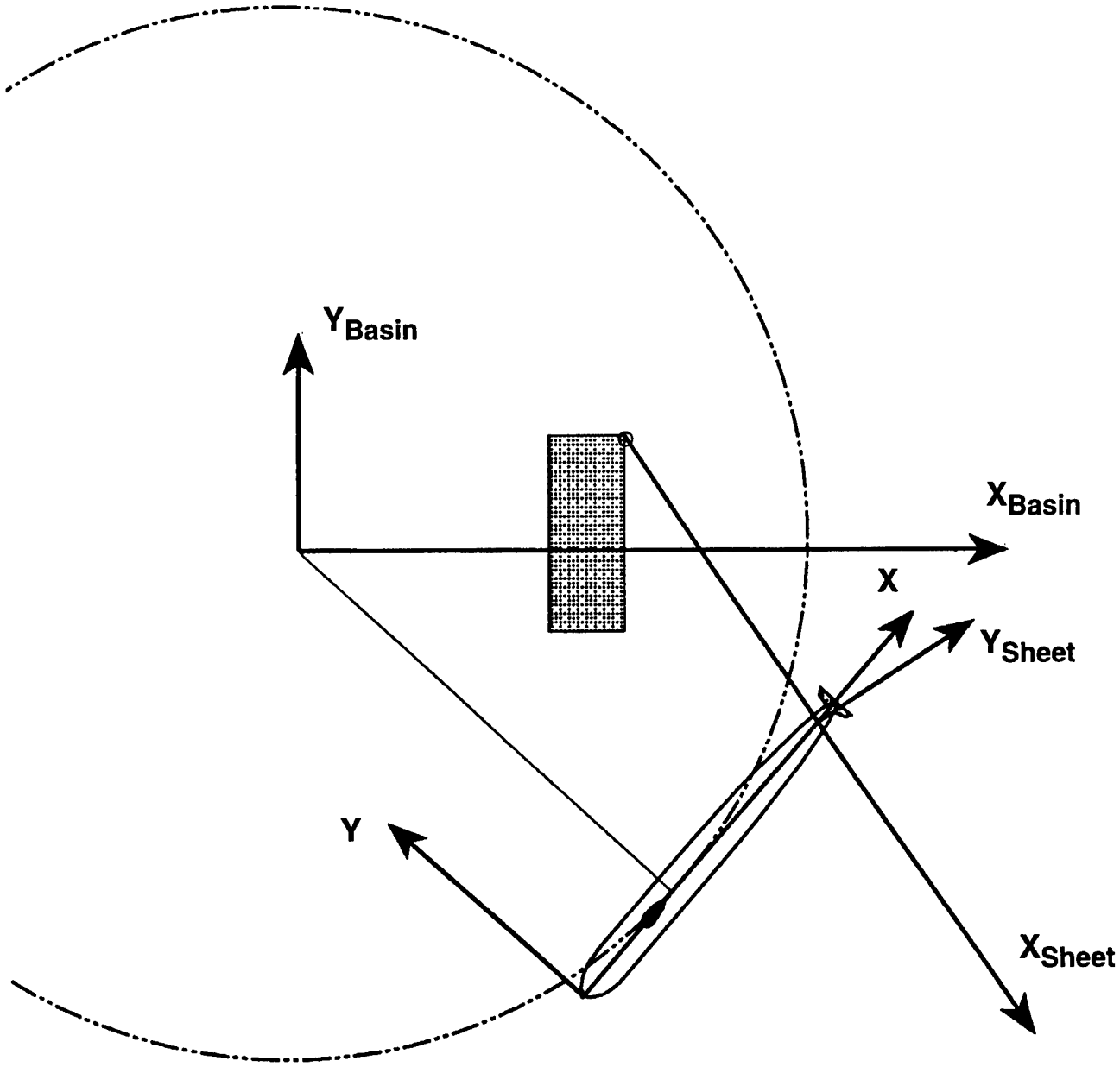

Figure D1 Coordinate system used in the data presentation

DARPA MODEL - Bare Hull
radius = 24.07700 feet
yaw = 16.00000 pitch = 0.0000000E+00 roll = 0.0
x/L = 0.7500000

x	y	z	v	w
12.567	3.635	0.543	0.000	0.000
12.570	3.577	0.543	0.000	0.000
12.572	3.519	0.543	0.000	0.000
12.575	3.461	0.543	0.000	0.000
12.578	3.403	0.543	0.000	0.000
12.581	3.345	0.543	0.000	0.000
12.584	3.286	0.543	0.000	0.000
12.587	3.228	0.543	0.000	0.000
12.590	3.170	0.543	0.000	0.000
12.593	3.112	0.543	0.000	0.000
12.596	3.054	0.543	0.000	0.000
12.599	2.996	0.543	0.000	0.000
12.602	2.937	0.543	0.000	0.000
12.605	2.879	0.543	0.000	0.000
12.608	2.821	0.543	0.000	0.000
12.611	2.763	0.543	0.000	0.000
12.614	2.705	0.543	0.000	0.000
12.616	2.647	0.543	0.000	0.000
12.619	2.588	0.543	0.000	0.000
12.622	2.530	0.543	6.699	2.133
12.625	2.472	0.543	0.000	0.000
12.628	2.414	0.543	0.000	0.000
12.631	2.356	0.543	5.938	2.590
12.634	2.298	0.543	0.000	0.000
12.637	2.239	0.543	6.851	3.808
12.640	2.181	0.543	0.000	0.000
12.643	2.123	0.543	0.000	0.000
12.646	2.065	0.543	0.000	0.000
12.649	2.007	0.543	0.000	0.000
12.652	1.949	0.543	0.000	0.000
12.655	1.890	0.543	0.000	0.000
12.658	1.832	0.543	0.000	0.000
12.660	1.774	0.543	0.000	0.000
12.663	1.716	0.543	0.000	0.000
12.666	1.658	0.543	0.000	0.000
12.669	1.600	0.543	0.000	0.000
12.672	1.541	0.543	0.000	0.000
12.675	1.483	0.543	0.000	0.000
12.678	1.425	0.543	0.000	0.000
12.681	1.367	0.543	0.000	0.000
12.684	1.309	0.543	0.000	0.000
12.687	1.251	0.543	0.000	0.000
12.690	1.192	0.543	0.000	0.000
12.693	1.134	0.543	0.000	0.000
12.696	1.076	0.543	0.000	0.000
12.699	1.018	0.543	0.000	0.000
12.702	0.960	0.543	0.000	0.000
12.705	0.902	0.543	0.000	0.000
12.707	0.843	0.543	0.000	0.000

12.710	0.785	0.543	0.000	0.000
12.713	0.727	0.543	0.000	0.000
12.716	0.669	0.543	0.000	0.000
12.719	0.611	0.543	0.000	0.000
12.567	3.635	0.485	0.000	0.000
12.570	3.577	0.485	0.000	0.000
12.572	3.519	0.485	0.000	0.000
12.575	3.461	0.485	0.000	0.000
12.578	3.403	0.485	0.000	0.000
12.581	3.345	0.485	0.000	0.000
12.584	3.286	0.485	0.000	0.000
12.587	3.228	0.485	4.872	1.523
12.590	3.170	0.485	0.000	0.000
12.593	3.112	0.485	0.000	0.000
12.596	3.054	0.485	3.350	1.828
12.599	2.996	0.485	0.000	0.000
12.602	2.937	0.485	3.806	1.676
12.605	2.879	0.485	0.000	0.000
12.608	2.821	0.485	0.000	0.000
12.611	2.763	0.485	0.000	0.000
12.614	2.705	0.485	0.000	0.000
12.616	2.647	0.485	0.000	0.000
12.619	2.588	0.485	0.000	0.000
12.622	2.530	0.485	0.000	0.000
12.625	2.472	0.485	0.000	0.000
12.628	2.414	0.485	0.000	0.000
12.631	2.356	0.485	0.000	0.000
12.634	2.298	0.485	0.000	0.000
12.637	2.239	0.485	0.000	0.000
12.640	2.181	0.485	0.000	0.000
12.643	2.123	0.485	6.851	3.199
12.646	2.065	0.485	0.000	0.000
12.649	2.007	0.485	0.000	0.000
12.652	1.949	0.485	0.000	0.000
12.655	1.890	0.485	4.893	3.200
12.658	1.832	0.485	0.000	0.000
12.660	1.774	0.485	5.457	4.895
12.663	1.716	0.485	0.000	0.000
12.666	1.658	0.485	0.000	0.000
12.669	1.600	0.485	4.704	7.342
12.672	1.541	0.485	0.000	0.000
12.675	1.483	0.485	5.269	7.342
12.678	1.425	0.485	0.000	0.000
12.681	1.367	0.485	0.000	0.000
12.684	1.309	0.485	0.000	0.000
12.687	1.251	0.485	0.000	0.000
12.690	1.192	0.485	0.000	0.000
12.693	1.134	0.485	6.870	5.936
12.696	1.076	0.485	0.000	0.000
12.699	1.018	0.485	0.000	0.000
12.702	0.960	0.485	0.000	0.000
12.705	0.902	0.485	0.000	0.000
12.707	0.843	0.485	0.000	0.000
12.710	0.785	0.485	0.000	0.000

12.713	0.727	0.485	0.000	0.000
12.716	0.669	0.485	0.000	0.000
12.719	0.611	0.485	0.000	0.000
12.567	3.635	0.427	0.000	0.000
12.570	3.577	0.427	0.000	0.000
12.572	3.519	0.427	0.000	0.000
12.575	3.461	0.427	0.000	0.000
12.578	3.403	0.427	0.000	0.000
12.581	3.345	0.427	4.568	1.066
12.584	3.286	0.427	0.000	0.000
12.587	3.228	0.427	0.000	0.000
12.590	3.170	0.427	3.959	0.914
12.593	3.112	0.427	0.000	0.000
12.596	3.054	0.427	3.045	1.066
12.599	2.996	0.427	0.000	0.000
12.602	2.937	0.427	0.000	0.000
12.605	2.879	0.427	4.568	1.828
12.608	2.821	0.427	5.308	3.124
12.611	2.763	0.427	0.000	0.000
12.614	2.705	0.427	0.000	0.000
12.616	2.647	0.427	0.000	0.000
12.619	2.588	0.427	0.000	0.000
12.622	2.530	0.427	0.000	0.000
12.625	2.472	0.427	0.000	0.000
12.628	2.414	0.427	0.000	0.000
12.631	2.356	0.427	0.000	0.000
12.634	2.298	0.427	0.000	0.000
12.637	2.239	0.427	5.938	2.437
12.640	2.181	0.427	0.000	0.000
12.643	2.123	0.427	0.000	0.000
12.646	2.065	0.427	0.000	0.000
12.649	2.007	0.427	0.000	0.000
12.652	1.949	0.427	0.000	0.000
12.655	1.890	0.427	0.000	0.000
12.658	1.832	0.427	0.000	0.000
12.660	1.774	0.427	0.000	0.000
12.663	1.716	0.427	0.000	0.000
12.666	1.658	0.427	0.000	0.000
12.669	1.600	0.427	0.000	0.000
12.672	1.541	0.427	0.000	0.000
12.675	1.483	0.427	0.000	0.000
12.678	1.425	0.427	5.645	4.518
12.681	1.367	0.427	0.000	0.000
12.684	1.309	0.427	0.000	0.000
12.687	1.251	0.427	0.000	0.000
12.690	1.192	0.427	0.000	0.000
12.693	1.134	0.427	0.000	0.000
12.696	1.076	0.427	0.000	0.000
12.699	1.018	0.427	0.000	0.000
12.702	0.960	0.427	0.000	0.000
12.705	0.902	0.427	0.000	0.000
12.707	0.843	0.427	0.000	0.000
12.710	0.785	0.427	0.000	0.000
12.713	0.727	0.427	0.000	0.000

12.716	0.669	0.427	0.000	0.000
12.719	0.611	0.427	0.000	0.000
12.567	3.635	0.368	0.000	0.000
12.570	3.577	0.368	4.720	0.609
12.572	3.519	0.368	4.568	0.914
12.575	3.461	0.368	0.000	0.000
12.578	3.403	0.368	0.000	0.000
12.581	3.345	0.368	0.000	0.000
12.584	3.286	0.368	0.000	0.000
12.587	3.228	0.368	4.415	1.676
12.590	3.170	0.368	0.000	0.000
12.593	3.112	0.368	0.000	0.000
12.596	3.054	0.368	0.000	0.000
12.599	2.996	0.368	0.000	0.000
12.602	2.937	0.368	4.568	2.133
12.605	2.879	0.368	0.000	0.000
12.608	2.821	0.368	0.000	0.000
12.611	2.763	0.368	0.000	0.000
12.614	2.705	0.368	3.959	1.371
12.616	2.647	0.368	0.000	0.000
12.619	2.588	0.368	4.872	1.523
12.622	2.530	0.368	0.000	0.000
12.625	2.472	0.368	0.000	0.000
12.628	2.414	0.368	5.933	3.437
12.631	2.356	0.368	0.000	0.000
12.634	2.298	0.368	0.000	0.000
12.637	2.239	0.368	5.481	1.523
12.640	2.181	0.368	0.000	0.000
12.643	2.123	0.368	5.177	1.371
12.646	2.065	0.368	0.000	0.000
12.649	2.007	0.368	7.182	3.749
12.652	1.949	0.368	6.962	3.012
12.655	1.890	0.368	0.000	0.000
12.658	1.832	0.368	0.000	0.000
12.660	1.774	0.368	0.000	0.000
12.663	1.716	0.368	0.000	0.000
12.666	1.658	0.368	6.586	4.518
12.669	1.600	0.368	0.000	0.000
12.672	1.541	0.368	0.000	0.000
12.675	1.483	0.368	0.000	0.000
12.678	1.425	0.368	0.000	0.000
12.681	1.367	0.368	0.000	0.000
12.684	1.309	0.368	0.000	0.000
12.687	1.251	0.368	0.000	0.000
12.690	1.192	0.368	0.000	0.000
12.693	1.134	0.368	0.000	0.000
12.696	1.076	0.368	0.000	0.000
12.699	1.018	0.368	0.000	0.000
12.702	0.960	0.368	0.000	0.000
12.705	0.902	0.368	0.000	0.000
12.707	0.843	0.368	0.000	0.000
12.710	0.785	0.368	0.000	0.000
12.713	0.727	0.368	0.000	0.000
12.716	0.669	0.368	0.000	0.000

12.719	0.611	0.368	0.000	0.000
12.567	3.635	0.310	0.000	0.000
12.570	3.577	0.310	4.415	0.609
12.572	3.519	0.310	0.000	0.000
12.575	3.461	0.310	0.000	0.000
12.578	3.403	0.310	4.415	0.000
12.581	3.345	0.310	0.000	0.000
12.584	3.286	0.310	0.000	0.000
12.587	3.228	0.310	0.000	0.000
12.590	3.170	0.310	0.000	0.000
12.593	3.112	0.310	4.111	1.676
12.596	3.054	0.310	0.000	0.000
12.599	2.996	0.310	0.000	0.000
12.602	2.937	0.310	7.308	2.285
12.605	2.879	0.310	4.720	1.219
12.608	2.821	0.310	6.870	3.437
12.611	2.763	0.310	4.263	1.523
12.614	2.705	0.310	0.000	0.000
12.616	2.647	0.310	0.000	0.000
12.619	2.588	0.310	0.000	0.000
12.622	2.530	0.310	7.156	1.523
12.625	2.472	0.310	0.000	0.000
12.628	2.414	0.310	0.000	0.000
12.631	2.356	0.310	0.000	0.000
12.634	2.298	0.310	5.024	1.371
12.637	2.239	0.310	0.000	0.000
12.640	2.181	0.310	0.000	0.000
12.643	2.123	0.310	7.004	1.676
12.646	2.065	0.310	0.000	0.000
12.649	2.007	0.310	0.000	0.000
12.652	1.949	0.310	0.000	0.000
12.655	1.890	0.310	0.000	0.000
12.658	1.832	0.310	0.000	0.000
12.660	1.774	0.310	9.785	3.012
12.663	1.716	0.310	8.844	5.271
12.666	1.658	0.310	0.000	0.000
12.669	1.600	0.310	0.000	0.000
12.672	1.541	0.310	0.000	0.000
12.675	1.483	0.310	0.000	0.000
12.678	1.425	0.310	0.000	0.000
12.681	1.367	0.310	6.870	4.061
12.684	1.309	0.310	0.000	0.000
12.687	1.251	0.310	0.000	0.000
12.690	1.192	0.310	0.000	0.000
12.693	1.134	0.310	0.000	0.000
12.696	1.076	0.310	0.000	0.000
12.699	1.018	0.310	0.000	0.000
12.702	0.960	0.310	0.000	0.000
12.705	0.902	0.310	0.000	0.000
12.707	0.843	0.310	0.000	0.000
12.710	0.785	0.310	0.000	0.000
12.713	0.727	0.310	0.000	0.000
12.716	0.669	0.310	0.000	0.000
12.719	0.611	0.310	0.000	0.000

12.567	3.635	0.252	0.000	0.000
12.570	3.577	0.252	3.654	0.609
12.572	3.519	0.252	3.350	-0.152
12.575	3.461	0.252	0.000	0.000
12.578	3.403	0.252	3.654	-0.305
12.581	3.345	0.252	0.000	0.000
12.584	3.286	0.252	0.000	0.000
12.587	3.228	0.252	5.177	0.914
12.590	3.170	0.252	4.415	0.457
12.593	3.112	0.252	0.000	0.000
12.596	3.054	0.252	4.568	1.676
12.599	2.996	0.252	0.000	0.000
12.602	2.937	0.252	0.000	0.000
12.605	2.879	0.252	0.000	0.000
12.608	2.821	0.252	4.872	1.219
12.611	2.763	0.252	0.000	0.000
12.614	2.705	0.252	0.000	0.000
12.616	2.647	0.252	4.111	0.914
12.619	2.588	0.252	0.000	0.000
12.622	2.530	0.252	0.000	0.000
12.625	2.472	0.252	7.156	1.523
12.628	2.414	0.252	7.807	1.562
12.631	2.356	0.252	0.000	0.000
12.634	2.298	0.252	0.000	0.000
12.637	2.239	0.252	0.000	0.000
12.640	2.181	0.252	0.000	0.000
12.643	2.123	0.252	0.000	0.000
12.646	2.065	0.252	6.242	1.371
12.649	2.007	0.252	0.000	0.000
12.652	1.949	0.252	6.870	2.187
12.655	1.890	0.252	0.000	0.000
12.658	1.832	0.252	0.000	0.000
12.660	1.774	0.252	0.000	0.000
12.663	1.716	0.252	0.000	0.000
12.666	1.658	0.252	0.000	0.000
12.669	1.600	0.252	0.000	0.000
12.672	1.541	0.252	7.527	3.200
12.675	1.483	0.252	0.000	0.000
12.678	1.425	0.252	9.032	3.954
12.681	1.367	0.252	0.000	0.000
12.684	1.309	0.252	0.000	0.000
12.687	1.251	0.252	0.000	0.000
12.690	1.192	0.252	0.000	0.000
12.693	1.134	0.252	0.000	0.000
12.696	1.076	0.252	0.000	0.000
12.699	1.018	0.252	0.000	0.000
12.702	0.960	0.252	0.000	0.000
12.705	0.902	0.252	0.000	0.000
12.707	0.843	0.252	0.000	0.000
12.710	0.785	0.252	0.000	0.000
12.713	0.727	0.252	0.000	0.000
12.716	0.669	0.252	0.000	0.000
12.719	0.611	0.252	0.000	0.000
12.567	3.635	0.194	0.000	0.000

12.570	3.577	0.194	0.000	0.000
12.572	3.519	0.194	0.000	0.000
12.575	3.461	0.194	0.000	0.000
12.578	3.403	0.194	3.654	0.762
12.581	3.345	0.194	3.502	0.152
12.584	3.286	0.194	4.720	1.219
12.587	3.228	0.194	0.000	0.000
12.590	3.170	0.194	4.415	0.457
12.593	3.112	0.194	0.000	0.000
12.596	3.054	0.194	0.000	0.000
12.599	2.996	0.194	4.263	0.305
12.602	2.937	0.194	5.177	0.609
12.605	2.879	0.194	0.000	0.000
12.608	2.821	0.194	0.000	0.000
12.611	2.763	0.194	0.000	0.000
12.614	2.705	0.194	6.090	1.828
12.616	2.647	0.194	5.786	0.457
12.619	2.588	0.194	0.000	0.000
12.622	2.530	0.194	6.547	1.676
12.625	2.472	0.194	0.000	0.000
12.628	2.414	0.194	0.000	0.000
12.631	2.356	0.194	0.000	0.000
12.634	2.298	0.194	0.000	0.000
12.637	2.239	0.194	0.000	0.000
12.640	2.181	0.194	0.000	0.000
12.643	2.123	0.194	0.000	0.000
12.646	2.065	0.194	0.000	0.000
12.649	2.007	0.194	0.000	0.000
12.652	1.949	0.194	0.000	0.000
12.655	1.890	0.194	0.000	0.000
12.658	1.832	0.194	0.000	0.000
12.660	1.774	0.194	0.000	0.000
12.663	1.716	0.194	0.000	0.000
12.666	1.658	0.194	6.962	1.883
12.669	1.600	0.194	0.000	0.000
12.672	1.541	0.194	0.000	0.000
12.675	1.483	0.194	6.245	1.874
12.678	1.425	0.194	0.000	0.000
12.681	1.367	0.194	0.000	0.000
12.684	1.309	0.194	0.000	0.000
12.687	1.251	0.194	7.527	2.447
12.690	1.192	0.194	0.000	0.000
12.693	1.134	0.194	0.000	0.000
12.696	1.076	0.194	0.000	0.000
12.699	1.018	0.194	0.000	0.000
12.702	0.960	0.194	0.000	0.000
12.705	0.902	0.194	0.000	0.000
12.707	0.843	0.194	0.000	0.000
12.710	0.785	0.194	0.000	0.000
12.713	0.727	0.194	0.000	0.000
12.716	0.669	0.194	0.000	0.000
12.719	0.611	0.194	0.000	0.000
12.567	3.635	0.135	0.000	0.000
12.570	3.577	0.135	4.263	0.305

12.572	3.519	0.135	0.000	0.000
12.575	3.461	0.135	5.024	0.152
12.578	3.403	0.135	0.000	0.000
12.581	3.345	0.135	4.720	0.000
12.584	3.286	0.135	0.000	0.000
12.587	3.228	0.135	5.786	0.762
12.590	3.170	0.135	4.415	1.066
12.593	3.112	0.135	0.000	0.000
12.596	3.054	0.135	4.872	1.371
12.599	2.996	0.135	5.938	0.762
12.602	2.937	0.135	0.000	0.000
12.605	2.879	0.135	6.090	1.066
12.608	2.821	0.135	0.000	0.000
12.611	2.763	0.135	6.242	0.762
12.614	2.705	0.135	0.000	0.000
12.616	2.647	0.135	0.000	0.000
12.619	2.588	0.135	6.547	1.066
12.622	2.530	0.135	0.000	0.000
12.625	2.472	0.135	0.000	0.000
12.628	2.414	0.135	6.699	0.914
12.631	2.356	0.135	0.000	0.000
12.634	2.298	0.135	8.222	1.523
12.637	2.239	0.135	6.851	-0.305
12.640	2.181	0.135	0.000	0.000
12.643	2.123	0.135	6.851	1.066
12.646	2.065	0.135	0.000	0.000
12.649	2.007	0.135	0.000	0.000
12.652	1.949	0.135	0.000	0.000
12.655	1.890	0.135	0.000	0.000
12.658	1.832	0.135	0.000	0.000
12.660	1.774	0.135	0.000	0.000
12.663	1.716	0.135	0.000	0.000
12.666	1.658	0.135	0.000	0.000
12.669	1.600	0.135	0.000	0.000
12.672	1.541	0.135	8.280	1.883
12.675	1.483	0.135	0.000	0.000
12.678	1.425	0.135	0.000	0.000
12.681	1.367	0.135	0.000	0.000
12.684	1.309	0.135	0.000	0.000
12.687	1.251	0.135	6.558	0.312
12.690	1.192	0.135	0.000	0.000
12.693	1.134	0.135	0.000	0.000
12.696	1.076	0.135	0.000	0.000
12.699	1.018	0.135	0.000	0.000
12.702	0.960	0.135	0.000	0.000
12.705	0.902	0.135	0.000	0.000
12.707	0.843	0.135	0.000	0.000
12.710	0.785	0.135	0.000	0.000
12.713	0.727	0.135	0.000	0.000
12.716	0.669	0.135	0.000	0.000
12.719	0.611	0.135	0.000	0.000
12.567	3.635	0.077	0.000	0.000
12.570	3.577	0.077	0.000	0.000
12.572	3.519	0.077	4.415	-0.457

12.575	3.461	0.077	0.000	0.000
12.578	3.403	0.077	0.000	0.000
12.581	3.345	0.077	4.568	1.676
12.584	3.286	0.077	0.000	0.000
12.587	3.228	0.077	0.000	0.000
12.590	3.170	0.077	0.000	0.000
12.593	3.112	0.077	4.872	0.305
12.596	3.054	0.077	0.000	0.000
12.599	2.996	0.077	0.000	0.000
12.602	2.937	0.077	0.000	0.000
12.605	2.879	0.077	0.000	0.000
12.608	2.821	0.077	0.000	0.000
12.611	2.763	0.077	0.000	0.000
12.614	2.705	0.077	0.000	0.000
12.616	2.647	0.077	5.329	-0.305
12.619	2.588	0.077	5.177	0.457
12.622	2.530	0.077	0.000	0.000
12.625	2.472	0.077	0.000	0.000
12.628	2.414	0.077	5.177	0.914
12.631	2.356	0.077	0.000	0.000
12.634	2.298	0.077	6.547	-0.152
12.637	2.239	0.077	6.699	0.000
12.640	2.181	0.077	0.000	0.000
12.643	2.123	0.077	0.000	0.000
12.646	2.065	0.077	0.000	0.000
12.649	2.007	0.077	0.000	0.000
12.652	1.949	0.077	0.000	0.000
12.655	1.890	0.077	9.785	1.883
12.658	1.832	0.077	0.000	0.000
12.660	1.774	0.077	0.000	0.000
12.663	1.716	0.077	0.000	0.000
12.666	1.658	0.077	8.092	1.130
12.669	1.600	0.077	0.000	0.000
12.672	1.541	0.077	7.527	0.565
12.675	1.483	0.077	0.000	0.000
12.678	1.425	0.077	0.000	0.000
12.681	1.367	0.077	0.000	0.000
12.684	1.309	0.077	0.000	0.000
12.687	1.251	0.077	0.000	0.000
12.690	1.192	0.077	0.000	0.000
12.693	1.134	0.077	0.000	0.000
12.696	1.076	0.077	0.000	0.000
12.699	1.018	0.077	0.000	0.000
12.702	0.960	0.077	0.000	0.000
12.705	0.902	0.077	0.000	0.000
12.707	0.843	0.077	0.000	0.000
12.710	0.785	0.077	0.000	0.000
12.713	0.727	0.077	0.000	0.000
12.716	0.669	0.077	0.000	0.000
12.719	0.611	0.077	0.000	0.000
12.567	3.635	0.019	3.502	0.609
12.570	3.577	0.019	0.000	0.000
12.572	3.519	0.019	4.568	-0.762
12.575	3.461	0.019	4.111	-0.762

12.578	3.403	0.019	0.000	0.000
12.581	3.345	0.019	3.350	2.133
12.584	3.286	0.019	0.000	0.000
12.587	3.228	0.019	5.786	1.828
12.590	3.170	0.019	0.000	0.000
12.593	3.112	0.019	0.000	0.000
12.596	3.054	0.019	4.872	-0.152
12.599	2.996	0.019	0.000	0.000
12.602	2.937	0.019	0.000	0.000
12.605	2.879	0.019	0.000	0.000
12.608	2.821	0.019	4.872	1.371
12.611	2.763	0.019	0.000	0.000
12.614	2.705	0.019	5.786	0.609
12.616	2.647	0.019	0.000	0.000
12.619	2.588	0.019	7.917	-0.609
12.622	2.530	0.019	0.000	0.000
12.625	2.472	0.019	0.000	0.000
12.628	2.414	0.019	0.000	0.000
12.631	2.356	0.019	0.000	0.000
12.634	2.298	0.019	0.000	0.000
12.637	2.239	0.019	9.368	-1.250
12.640	2.181	0.019	0.000	0.000
12.643	2.123	0.019	0.000	0.000
12.646	2.065	0.019	0.000	0.000
12.649	2.007	0.019	7.339	-0.188
12.652	1.949	0.019	0.000	0.000
12.655	1.890	0.019	0.000	0.000
12.658	1.832	0.019	0.000	0.000
12.660	1.774	0.019	0.000	0.000
12.663	1.716	0.019	0.000	0.000
12.666	1.658	0.019	0.000	0.000
12.669	1.600	0.019	0.000	0.000
12.672	1.541	0.019	0.000	0.000
12.675	1.483	0.019	0.000	0.000
12.678	1.425	0.019	0.000	0.000
12.681	1.367	0.019	0.000	0.000
12.684	1.309	0.019	0.000	0.000
12.687	1.251	0.019	0.000	0.000
12.690	1.192	0.019	0.000	0.000
12.693	1.134	0.019	0.000	0.000
12.696	1.076	0.019	0.000	0.000
12.699	1.018	0.019	0.000	0.000
12.702	0.960	0.019	0.000	0.000
12.705	0.902	0.019	0.000	0.000
12.707	0.843	0.019	0.000	0.000
12.710	0.785	0.019	0.000	0.000
12.713	0.727	0.019	0.000	0.000
12.716	0.669	0.019	0.000	0.000
12.719	0.611	0.019	0.000	0.000
12.567	3.635	-0.039	0.000	0.000
12.570	3.577	-0.039	0.000	0.000
12.572	3.519	-0.039	4.263	-0.914
12.575	3.461	-0.039	5.633	-1.523
12.578	3.403	-0.039	0.000	0.000

12.581	3.345	-0.039	0.000	0.000
12.584	3.286	-0.039	0.000	0.000
12.587	3.228	-0.039	5.177	0.914
12.590	3.170	-0.039	0.000	0.000
12.593	3.112	-0.039	0.000	0.000
12.596	3.054	-0.039	5.786	-0.305
12.599	2.996	-0.039	0.000	0.000
12.602	2.937	-0.039	0.000	0.000
12.605	2.879	-0.039	6.090	-1.066
12.608	2.821	-0.039	0.000	0.000
12.611	2.763	-0.039	6.395	-0.457
12.614	2.705	-0.039	0.000	0.000
12.616	2.647	-0.039	6.547	-0.152
12.619	2.588	-0.039	0.000	0.000
12.622	2.530	-0.039	0.000	0.000
12.625	2.472	-0.039	6.090	0.000
12.628	2.414	-0.039	0.000	0.000
12.631	2.356	-0.039	6.090	-0.457
12.634	2.298	-0.039	0.000	0.000
12.637	2.239	-0.039	0.000	0.000
12.640	2.181	-0.039	0.000	0.000
12.643	2.123	-0.039	6.851	-0.609
12.646	2.065	-0.039	0.000	0.000
12.649	2.007	-0.039	7.151	-1.318
12.652	1.949	-0.039	0.000	0.000
12.655	1.890	-0.039	0.000	0.000
12.658	1.832	-0.039	0.000	0.000
12.660	1.774	-0.039	10.350	2.447
12.663	1.716	-0.039	0.000	0.000
12.666	1.658	-0.039	0.000	0.000
12.669	1.600	-0.039	0.000	0.000
12.672	1.541	-0.039	0.000	0.000
12.675	1.483	-0.039	0.000	0.000
12.678	1.425	-0.039	0.000	0.000
12.681	1.367	-0.039	0.000	0.000
12.684	1.309	-0.039	0.000	0.000
12.687	1.251	-0.039	9.785	-1.130
12.690	1.192	-0.039	0.000	0.000
12.693	1.134	-0.039	0.000	0.000
12.696	1.076	-0.039	0.000	0.000
12.699	1.018	-0.039	8.280	0.377
12.702	0.960	-0.039	0.000	0.000
12.705	0.902	-0.039	0.000	0.000
12.707	0.843	-0.039	7.527	0.753
12.710	0.785	-0.039	0.000	0.000
12.713	0.727	-0.039	0.000	0.000
12.716	0.669	-0.039	0.000	0.000
12.719	0.611	-0.039	0.000	0.000
12.567	3.635	-0.098	0.000	0.000
12.570	3.577	-0.098	3.959	-0.305
12.572	3.519	-0.098	0.000	0.000
12.575	3.461	-0.098	0.000	0.000
12.578	3.403	-0.098	3.197	0.000
12.581	3.345	-0.098	4.415	0.000

12.584	3.286	-0.098	4.872	-0.305
12.587	3.228	-0.098	0.000	0.000
12.590	3.170	-0.098	0.000	0.000
12.593	3.112	-0.098	5.177	-1.219
12.596	3.054	-0.098	5.633	-0.762
12.599	2.996	-0.098	0.000	0.000
12.602	2.937	-0.098	6.090	-0.762
12.605	2.879	-0.098	0.000	0.000
12.608	2.821	-0.098	5.633	-1.066
12.611	2.763	-0.098	0.000	0.000
12.614	2.705	-0.098	0.000	0.000
12.616	2.647	-0.098	5.481	-1.219
12.619	2.588	-0.098	0.000	0.000
12.622	2.530	-0.098	4.872	-0.305
12.625	2.472	-0.098	0.000	0.000
12.628	2.414	-0.098	8.222	-0.609
12.631	2.356	-0.098	0.000	0.000
12.634	2.298	-0.098	0.000	0.000
12.637	2.239	-0.098	7.460	2.285
12.640	2.181	-0.098	5.329	-1.219
12.643	2.123	-0.098	7.004	-1.523
12.646	2.065	-0.098	0.000	0.000
12.649	2.007	-0.098	8.468	2.259
12.652	1.949	-0.098	0.000	0.000
12.655	1.890	-0.098	0.000	0.000
12.658	1.832	-0.098	0.000	0.000
12.660	1.774	-0.098	8.656	3.389
12.663	1.716	-0.098	0.000	0.000
12.666	1.658	-0.098	7.151	2.447
12.669	1.600	-0.098	8.280	3.577
12.672	1.541	-0.098	0.000	0.000
12.675	1.483	-0.098	0.000	0.000
12.678	1.425	-0.098	8.656	3.200
12.681	1.367	-0.098	0.000	0.000
12.684	1.309	-0.098	0.000	0.000
12.687	1.251	-0.098	0.000	0.000
12.690	1.192	-0.098	0.000	0.000
12.693	1.134	-0.098	0.000	0.000
12.696	1.076	-0.098	0.000	0.000
12.699	1.018	-0.098	0.000	0.000
12.702	0.960	-0.098	0.000	0.000
12.705	0.902	-0.098	0.000	0.000
12.707	0.843	-0.098	0.000	0.000
12.710	0.785	-0.098	0.000	0.000
12.713	0.727	-0.098	0.000	0.000
12.716	0.669	-0.098	0.000	0.000
12.719	0.611	-0.098	0.000	0.000
12.567	3.635	-0.156	0.000	0.000
12.570	3.577	-0.156	3.197	-1.219
12.572	3.519	-0.156	0.000	0.000
12.575	3.461	-0.156	3.806	0.305
12.578	3.403	-0.156	0.000	0.000
12.581	3.345	-0.156	0.000	0.000
12.584	3.286	-0.156	4.111	-1.066

12.587	3.228	-0.156	0.000	0.000
12.590	3.170	-0.156	5.024	-1.066
12.593	3.112	-0.156	0.000	0.000
12.596	3.054	-0.156	0.000	0.000
12.599	2.996	-0.156	0.000	0.000
12.602	2.937	-0.156	0.000	0.000
12.605	2.879	-0.156	6.395	-0.609
12.608	2.821	-0.156	0.000	0.000
12.611	2.763	-0.156	5.177	-0.762
12.614	2.705	-0.156	0.000	0.000
12.616	2.647	-0.156	0.000	0.000
12.619	2.588	-0.156	5.481	-0.609
12.622	2.530	-0.156	0.000	0.000
12.625	2.472	-0.156	5.786	-1.523
12.628	2.414	-0.156	0.000	0.000
12.631	2.356	-0.156	5.633	-1.371
12.634	2.298	-0.156	0.000	0.000
12.637	2.239	-0.156	4.720	-1.219
12.640	2.181	-0.156	0.000	0.000
12.643	2.123	-0.156	6.090	2.133
12.646	2.065	-0.156	0.000	0.000
12.649	2.007	-0.156	0.000	0.000
12.652	1.949	-0.156	0.000	0.000
12.655	1.890	-0.156	0.000	0.000
12.658	1.832	-0.156	7.151	3.200
12.660	1.774	-0.156	9.973	4.518
12.663	1.716	-0.156	0.000	0.000
12.666	1.658	-0.156	0.000	0.000
12.669	1.600	-0.156	0.000	0.000
12.672	1.541	-0.156	6.398	3.389
12.675	1.483	-0.156	8.092	4.330
12.678	1.425	-0.156	0.000	0.000
12.681	1.367	-0.156	0.000	0.000
12.684	1.309	-0.156	0.000	0.000
12.687	1.251	-0.156	8.656	-0.377
12.690	1.192	-0.156	0.000	0.000
12.693	1.134	-0.156	6.962	-0.377
12.696	1.076	-0.156	0.000	0.000
12.699	1.018	-0.156	0.000	0.000
12.702	0.960	-0.156	0.000	0.000
12.705	0.902	-0.156	0.000	0.000
12.707	0.843	-0.156	0.000	0.000
12.710	0.785	-0.156	0.000	0.000
12.713	0.727	-0.156	0.000	0.000
12.716	0.669	-0.156	0.000	0.000
12.719	0.611	-0.156	0.000	0.000
12.567	3.635	-0.214	0.000	0.000
12.570	3.577	-0.214	3.959	-1.219
12.572	3.519	-0.214	0.000	0.000
12.575	3.461	-0.214	0.000	0.000
12.578	3.403	-0.214	3.197	-0.914
12.581	3.345	-0.214	3.654	-0.762
12.584	3.286	-0.214	0.000	0.000
12.587	3.228	-0.214	4.568	-0.609

12.590	3.170	-0.214	0.000	0.000
12.593	3.112	-0.214	0.000	0.000
12.596	3.054	-0.214	5.024	-1.219
12.599	2.996	-0.214	0.000	0.000
12.602	2.937	-0.214	0.000	0.000
12.605	2.879	-0.214	5.024	-1.523
12.608	2.821	-0.214	0.000	0.000
12.611	2.763	-0.214	4.872	-0.914
12.614	2.705	-0.214	0.000	0.000
12.616	2.647	-0.214	0.000	0.000
12.619	2.588	-0.214	5.481	-1.371
12.622	2.530	-0.214	0.000	0.000
12.625	2.472	-0.214	0.000	0.000
12.628	2.414	-0.214	7.613	3.351
12.631	2.356	-0.214	0.000	0.000
12.634	2.298	-0.214	0.000	0.000
12.637	2.239	-0.214	4.568	-1.523
12.640	2.181	-0.214	0.000	0.000
12.643	2.123	-0.214	0.000	0.000
12.646	2.065	-0.214	0.000	0.000
12.649	2.007	-0.214	0.000	0.000
12.652	1.949	-0.214	7.715	3.577
12.655	1.890	-0.214	7.903	3.389
12.658	1.832	-0.214	0.000	0.000
12.660	1.774	-0.214	0.000	0.000
12.663	1.716	-0.214	7.527	4.330
12.666	1.658	-0.214	0.000	0.000
12.669	1.600	-0.214	0.000	0.000
12.672	1.541	-0.214	0.000	0.000
12.675	1.483	-0.214	0.000	0.000
12.678	1.425	-0.214	0.000	0.000
12.681	1.367	-0.214	0.000	0.000
12.684	1.309	-0.214	0.000	0.000
12.687	1.251	-0.214	0.000	0.000
12.690	1.192	-0.214	0.000	0.000
12.693	1.134	-0.214	0.000	0.000
12.696	1.076	-0.214	9.032	-1.130
12.699	1.018	-0.214	0.000	0.000
12.702	0.960	-0.214	0.000	0.000
12.705	0.902	-0.214	8.844	1.130
12.707	0.843	-0.214	0.000	0.000
12.710	0.785	-0.214	0.000	0.000
12.713	0.727	-0.214	0.000	0.000
12.716	0.669	-0.214	0.000	0.000
12.719	0.611	-0.214	0.000	0.000
12.567	3.635	-0.272	0.000	0.000
12.570	3.577	-0.272	3.350	-0.762
12.572	3.519	-0.272	0.000	0.000
12.575	3.461	-0.272	3.959	-1.371
12.578	3.403	-0.272	4.720	-1.066
12.581	3.345	-0.272	3.502	-1.523
12.584	3.286	-0.272	3.350	-1.219
12.587	3.228	-0.272	0.000	0.000
12.590	3.170	-0.272	4.568	-1.371

12.593	3.112	-0.272	3.959	-1.371
12.596	3.054	-0.272	0.000	0.000
12.599	2.996	-0.272	5.938	-1.219
12.602	2.937	-0.272	5.177	-1.676
12.605	2.879	-0.272	0.000	0.000
12.608	2.821	-0.272	5.938	3.047
12.611	2.763	-0.272	0.000	0.000
12.614	2.705	-0.272	7.156	3.199
12.616	2.647	-0.272	7.765	2.133
12.619	2.588	-0.272	0.000	0.000
12.622	2.530	-0.272	0.000	0.000
12.625	2.472	-0.272	0.000	0.000
12.628	2.414	-0.272	0.000	0.000
12.631	2.356	-0.272	0.000	0.000
12.634	2.298	-0.272	0.000	0.000
12.637	2.239	-0.272	6.395	2.742
12.640	2.181	-0.272	0.000	0.000
12.643	2.123	-0.272	5.481	2.742
12.646	2.065	-0.272	0.000	0.000
12.649	2.007	-0.272	8.656	3.577
12.652	1.949	-0.272	0.000	0.000
12.655	1.890	-0.272	0.000	0.000
12.658	1.832	-0.272	0.000	0.000
12.660	1.774	-0.272	7.339	5.271
12.663	1.716	-0.272	0.000	0.000
12.666	1.658	-0.272	0.000	0.000
12.669	1.600	-0.272	0.000	0.000
12.672	1.541	-0.272	7.339	6.213
12.675	1.483	-0.272	0.000	0.000
12.678	1.425	-0.272	6.398	6.213
12.681	1.367	-0.272	0.000	0.000
12.684	1.309	-0.272	0.000	0.000
12.687	1.251	-0.272	9.785	5.271
12.690	1.192	-0.272	0.000	0.000
12.693	1.134	-0.272	0.000	0.000
12.696	1.076	-0.272	0.000	0.000
12.699	1.018	-0.272	0.000	0.000
12.702	0.960	-0.272	7.903	1.506
12.705	0.902	-0.272	0.000	0.000
12.707	0.843	-0.272	0.000	0.000
12.710	0.785	-0.272	0.000	0.000
12.713	0.727	-0.272	0.000	0.000
12.716	0.669	-0.272	0.000	0.000
12.719	0.611	-0.272	0.000	0.000
12.567	3.635	-0.331	0.000	0.000
12.570	3.577	-0.331	4.263	-1.371
12.572	3.519	-0.331	3.197	2.285
12.575	3.461	-0.331	0.000	0.000
12.578	3.403	-0.331	0.000	0.000
12.581	3.345	-0.331	4.263	2.133
12.584	3.286	-0.331	3.959	-1.371
12.587	3.228	-0.331	0.000	0.000
12.590	3.170	-0.331	3.806	2.133
12.593	3.112	-0.331	0.000	0.000

12.596	3.054	-0.331	0.000	0.000
12.599	2.996	-0.331	4.872	-1.371
12.602	2.937	-0.331	0.000	0.000
12.605	2.879	-0.331	0.000	0.000
12.608	2.821	-0.331	5.786	2.590
12.611	2.763	-0.331	0.000	0.000
12.614	2.705	-0.331	0.000	0.000
12.616	2.647	-0.331	0.000	0.000
12.619	2.588	-0.331	5.329	1.980
12.622	2.530	-0.331	5.938	2.590
12.625	2.472	-0.331	0.000	0.000
12.628	2.414	-0.331	7.156	3.351
12.631	2.356	-0.331	0.000	0.000
12.634	2.298	-0.331	6.699	3.351
12.637	2.239	-0.331	0.000	0.000
12.640	2.181	-0.331	0.000	0.000
12.643	2.123	-0.331	7.765	3.656
12.646	2.065	-0.331	0.000	0.000
12.649	2.007	-0.331	8.656	4.142
12.652	1.949	-0.331	0.000	0.000
12.655	1.890	-0.331	0.000	0.000
12.658	1.832	-0.331	0.000	0.000
12.660	1.774	-0.331	7.527	6.966
12.663	1.716	-0.331	6.210	7.342
12.666	1.658	-0.331	0.000	0.000
12.669	1.600	-0.331	0.000	0.000
12.672	1.541	-0.331	0.000	0.000
12.675	1.483	-0.331	0.000	0.000
12.678	1.425	-0.331	0.000	0.000
12.681	1.367	-0.331	0.000	0.000
12.684	1.309	-0.331	0.000	0.000
12.687	1.251	-0.331	0.000	0.000
12.690	1.192	-0.331	6.022	3.954
12.693	1.134	-0.331	0.000	0.000
12.696	1.076	-0.331	0.000	0.000
12.699	1.018	-0.331	0.000	0.000
12.702	0.960	-0.331	0.000	0.000
12.705	0.902	-0.331	0.000	0.000
12.707	0.843	-0.331	0.000	0.000
12.710	0.785	-0.331	0.000	0.000
12.713	0.727	-0.331	0.000	0.000
12.716	0.669	-0.331	0.000	0.000
12.719	0.611	-0.331	0.000	0.000
12.567	3.635	-0.389	0.000	0.000
12.570	3.577	-0.389	0.000	0.000
12.572	3.519	-0.389	0.000	0.000
12.575	3.461	-0.389	3.959	-1.219
12.578	3.403	-0.389	0.000	0.000
12.581	3.345	-0.389	4.415	1.828
12.584	3.286	-0.389	0.000	0.000
12.587	3.228	-0.389	5.329	2.133
12.590	3.170	-0.389	3.959	-1.523
12.593	3.112	-0.389	3.502	-1.219
12.596	3.054	-0.389	0.000	0.000

12.599	2.996	-0.389	5.177	1.828
12.602	2.937	-0.389	0.000	0.000
12.605	2.879	-0.389	5.024	2.133
12.608	2.821	-0.389	6.090	2.742
12.611	2.763	-0.389	0.000	0.000
12.614	2.705	-0.389	0.000	0.000
12.616	2.647	-0.389	5.481	2.133
12.619	2.588	-0.389	7.308	3.808
12.622	2.530	-0.389	0.000	0.000
12.625	2.472	-0.389	0.000	0.000
12.628	2.414	-0.389	0.000	0.000
12.631	2.356	-0.389	7.460	4.113
12.634	2.298	-0.389	6.699	3.960
12.637	2.239	-0.389	0.000	0.000
12.640	2.181	-0.389	0.000	0.000
12.643	2.123	-0.389	0.000	0.000
12.646	2.065	-0.389	0.000	0.000
12.649	2.007	-0.389	0.000	0.000
12.652	1.949	-0.389	7.715	4.518
12.655	1.890	-0.389	0.000	0.000
12.658	1.832	-0.389	0.000	0.000
12.660	1.774	-0.389	0.000	0.000
12.663	1.716	-0.389	0.000	0.000
12.666	1.658	-0.389	0.000	0.000
12.669	1.600	-0.389	0.000	0.000
12.672	1.541	-0.389	0.000	0.000
12.675	1.483	-0.389	5.645	6.213
12.678	1.425	-0.389	0.000	0.000
12.681	1.367	-0.389	0.000	0.000
12.684	1.309	-0.389	0.000	0.000
12.687	1.251	-0.389	0.000	0.000
12.690	1.192	-0.389	0.000	0.000
12.693	1.134	-0.389	0.000	0.000
12.696	1.076	-0.389	0.000	0.000
12.699	1.018	-0.389	5.833	0.377
12.702	0.960	-0.389	0.000	0.000
12.705	0.902	-0.389	0.000	0.000
12.707	0.843	-0.389	0.000	0.000
12.710	0.785	-0.389	0.000	0.000
12.713	0.727	-0.389	0.000	0.000
12.716	0.669	-0.389	0.000	0.000
12.719	0.611	-0.389	0.000	0.000
12.567	3.635	-0.447	0.000	0.000
12.570	3.577	-0.447	3.654	1.980
12.572	3.519	-0.447	3.502	1.828
12.575	3.461	-0.447	5.829	3.207
12.578	3.403	-0.447	0.000	0.000
12.581	3.345	-0.447	3.959	-1.676
12.584	3.286	-0.447	4.111	1.828
12.587	3.228	-0.447	0.000	0.000
12.590	3.170	-0.447	0.000	0.000
12.593	3.112	-0.447	4.111	2.133
12.596	3.054	-0.447	0.000	0.000
12.599	2.996	-0.447	5.024	2.437

12.602	2.937	-0.447	0.000	0.000
12.605	2.879	-0.447	0.000	0.000
12.608	2.821	-0.447	0.000	0.000
12.611	2.763	-0.447	6.699	3.199
12.614	2.705	-0.447	0.000	0.000
12.616	2.647	-0.447	0.000	0.000
12.619	2.588	-0.447	5.975	3.936
12.622	2.530	-0.447	0.000	0.000
12.625	2.472	-0.447	6.090	3.351
12.628	2.414	-0.447	6.699	3.199
12.631	2.356	-0.447	0.000	0.000
12.634	2.298	-0.447	0.000	0.000
12.637	2.239	-0.447	5.829	3.499
12.640	2.181	-0.447	0.000	0.000
12.643	2.123	-0.447	6.586	5.648
12.646	2.065	-0.447	6.242	4.265
12.649	2.007	-0.447	0.000	0.000
12.652	1.949	-0.447	5.786	6.093
12.655	1.890	-0.447	0.000	0.000
12.658	1.832	-0.447	0.000	0.000
12.660	1.774	-0.447	0.000	0.000
12.663	1.716	-0.447	0.000	0.000
12.666	1.658	-0.447	4.516	7.531
12.669	1.600	-0.447	0.000	0.000
12.672	1.541	-0.447	3.045	5.636
12.675	1.483	-0.447	0.000	0.000
12.678	1.425	-0.447	0.000	0.000
12.681	1.367	-0.447	3.575	8.848
12.684	1.309	-0.447	3.197	7.464
12.687	1.251	-0.447	0.000	0.000
12.690	1.192	-0.447	0.000	0.000
12.693	1.134	-0.447	0.000	0.000
12.696	1.076	-0.447	0.000	0.000
12.699	1.018	-0.447	4.263	2.894
12.702	0.960	-0.447	0.000	0.000
12.705	0.902	-0.447	0.000	0.000
12.707	0.843	-0.447	0.000	0.000
12.710	0.785	-0.447	0.000	0.000
12.713	0.727	-0.447	0.000	0.000
12.716	0.669	-0.447	0.000	0.000
12.719	0.611	-0.447	0.000	0.000
12.567	3.635	-0.505	0.000	0.000
12.570	3.577	-0.505	0.000	0.000
12.572	3.519	-0.505	0.000	0.000
12.575	3.461	-0.505	3.806	-1.371
12.578	3.403	-0.505	0.000	0.000
12.581	3.345	-0.505	5.100	2.624
12.584	3.286	-0.505	4.663	2.624
12.587	3.228	-0.505	5.683	2.333
12.590	3.170	-0.505	0.000	0.000
12.593	3.112	-0.505	4.226	2.333
12.596	3.054	-0.505	0.000	0.000
12.599	2.996	-0.505	0.000	0.000
12.602	2.937	-0.505	4.872	2.742

12.605	2.879	-0.505	0.000	0.000
12.608	2.821	-0.505	4.663	3.207
12.611	2.763	-0.505	0.000	0.000
12.614	2.705	-0.505	5.392	3.062
12.616	2.647	-0.505	4.955	3.207
12.619	2.588	-0.505	0.000	0.000
12.622	2.530	-0.505	4.955	3.062
12.625	2.472	-0.505	0.000	0.000
12.628	2.414	-0.505	5.537	3.645
12.631	2.356	-0.505	0.000	0.000
12.634	2.298	-0.505	0.000	0.000
12.637	2.239	-0.505	0.000	0.000
12.640	2.181	-0.505	6.120	4.520
12.643	2.123	-0.505	0.000	0.000
12.646	2.065	-0.505	5.329	3.960
12.649	2.007	-0.505	7.460	6.398
12.652	1.949	-0.505	0.000	0.000
12.655	1.890	-0.505	4.872	5.484
12.658	1.832	-0.505	0.000	0.000
12.660	1.774	-0.505	4.415	6.702
12.663	1.716	-0.505	0.000	0.000
12.666	1.658	-0.505	0.000	0.000
12.669	1.600	-0.505	0.000	0.000
12.672	1.541	-0.505	0.000	0.000
12.675	1.483	-0.505	2.893	8.226
12.678	1.425	-0.505	0.000	0.000
12.681	1.367	-0.505	0.000	0.000
12.684	1.309	-0.505	0.000	0.000
12.687	1.251	-0.505	0.000	0.000
12.690	1.192	-0.505	2.446	6.589
12.693	1.134	-0.505	1.675	2.894
12.696	1.076	-0.505	0.000	0.000
12.699	1.018	-0.505	2.132	1.066
12.702	0.960	-0.505	0.000	0.000
12.705	0.902	-0.505	0.000	0.000
12.707	0.843	-0.505	0.000	0.000
12.710	0.785	-0.505	0.000	0.000
12.713	0.727	-0.505	0.000	0.000
12.716	0.669	-0.505	0.000	0.000
12.719	0.611	-0.505	0.000	0.000
12.567	3.635	-0.564	0.000	0.000
12.570	3.577	-0.564	3.350	1.828
12.572	3.519	-0.564	0.000	0.000
12.575	3.461	-0.564	4.663	-1.750
12.578	3.403	-0.564	0.000	0.000
12.581	3.345	-0.564	4.226	2.478
12.584	3.286	-0.564	4.663	2.478
12.587	3.228	-0.564	0.000	0.000
12.590	3.170	-0.564	4.372	-1.750
12.593	3.112	-0.564	0.000	0.000
12.596	3.054	-0.564	4.809	2.624
12.599	2.996	-0.564	3.935	2.770
12.602	2.937	-0.564	0.000	0.000
12.605	2.879	-0.564	4.080	2.916

12.608	2.821	-0.564	0.000	0.000
12.611	2.763	-0.564	0.000	0.000
12.614	2.705	-0.564	4.809	2.770
12.616	2.647	-0.564	0.000	0.000
12.619	2.588	-0.564	5.392	3.499
12.622	2.530	-0.564	6.266	3.791
12.625	2.472	-0.564	0.000	0.000
12.628	2.414	-0.564	5.683	3.791
12.631	2.356	-0.564	6.120	4.665
12.634	2.298	-0.564	5.246	4.082
12.637	2.239	-0.564	0.000	0.000
12.640	2.181	-0.564	5.246	4.811
12.643	2.123	-0.564	5.633	5.331
12.646	2.065	-0.564	5.786	5.941
12.649	2.007	-0.564	5.481	6.093
12.652	1.949	-0.564	0.000	0.000
12.655	1.890	-0.564	0.000	0.000
12.658	1.832	-0.564	4.872	6.245
12.660	1.774	-0.564	0.000	0.000
12.663	1.716	-0.564	0.000	0.000
12.666	1.658	-0.564	2.893	6.093
12.669	1.600	-0.564	1.066	7.159
12.672	1.541	-0.564	0.000	0.000
12.675	1.483	-0.564	1.370	7.616
12.678	1.425	-0.564	0.000	0.000
12.681	1.367	-0.564	0.152	7.616
12.684	1.309	-0.564	0.000	0.000
12.687	1.251	-0.564	0.000	0.000
12.690	1.192	-0.564	0.000	0.000
12.693	1.134	-0.564	0.000	0.000
12.696	1.076	-0.564	1.675	3.047
12.699	1.018	-0.564	0.000	0.000
12.702	0.960	-0.564	0.000	0.000
12.705	0.902	-0.564	1.218	2.590
12.707	0.843	-0.564	0.000	0.000
12.710	0.785	-0.564	0.000	0.000
12.713	0.727	-0.564	0.000	0.000
12.716	0.669	-0.564	0.000	0.000
12.719	0.611	-0.564	0.000	0.000
12.567	3.635	-0.622	0.000	0.000
12.570	3.577	-0.622	0.000	0.000
12.572	3.519	-0.622	4.517	-1.312
12.575	3.461	-0.622	0.000	0.000
12.578	3.403	-0.622	0.000	0.000
12.581	3.345	-0.622	0.000	0.000
12.584	3.286	-0.622	0.000	0.000
12.587	3.228	-0.622	0.000	0.000
12.590	3.170	-0.622	0.000	0.000
12.593	3.112	-0.622	0.000	0.000
12.596	3.054	-0.622	4.809	2.478
12.599	2.996	-0.622	0.000	0.000
12.602	2.937	-0.622	4.663	2.916
12.605	2.879	-0.622	0.000	0.000
12.608	2.821	-0.622	4.809	3.353

12.611	2.763	-0.622	4.517	3.207
12.614	2.705	-0.622	5.246	3.791
12.616	2.647	-0.622	0.000	0.000
12.619	2.588	-0.622	0.000	0.000
12.622	2.530	-0.622	4.226	3.353
12.625	2.472	-0.622	0.000	0.000
12.628	2.414	-0.622	6.412	4.665
12.631	2.356	-0.622	0.000	0.000
12.634	2.298	-0.622	0.000	0.000
12.637	2.239	-0.622	0.000	0.000
12.640	2.181	-0.622	5.246	5.394
12.643	2.123	-0.622	0.000	0.000
12.646	2.065	-0.622	6.090	6.550
12.649	2.007	-0.622	0.000	0.000
12.652	1.949	-0.622	4.872	4.722
12.655	1.890	-0.622	0.000	0.000
12.658	1.832	-0.622	4.415	5.484
12.660	1.774	-0.622	3.654	4.722
12.663	1.716	-0.622	2.588	5.941
12.666	1.658	-0.622	2.284	5.484
12.669	1.600	-0.622	0.000	0.000
12.672	1.541	-0.622	3.197	6.398
12.675	1.483	-0.622	0.000	0.000
12.678	1.425	-0.622	2.132	8.530
12.681	1.367	-0.622	0.000	0.000
12.684	1.309	-0.622	0.000	0.000
12.687	1.251	-0.622	1.523	7.312
12.690	1.192	-0.622	-0.914	7.464
12.693	1.134	-0.622	-1.827	5.636
12.696	1.076	-0.622	0.000	0.000
12.699	1.018	-0.622	0.000	0.000
12.702	0.960	-0.622	2.132	2.742
12.705	0.902	-0.622	3.197	1.980
12.707	0.843	-0.622	2.741	1.828
12.710	0.785	-0.622	0.000	0.000
12.713	0.727	-0.622	0.000	0.000
12.716	0.669	-0.622	0.000	0.000
12.719	0.611	-0.622	0.000	0.000
12.567	3.635	-0.680	0.000	0.000
12.570	3.577	-0.680	4.080	-1.458
12.572	3.519	-0.680	0.000	0.000
12.575	3.461	-0.680	4.080	-1.458
12.578	3.403	-0.680	0.000	0.000
12.581	3.345	-0.680	0.000	0.000
12.584	3.286	-0.680	4.226	2.187
12.587	3.228	-0.680	0.000	0.000
12.590	3.170	-0.680	4.226	2.916
12.593	3.112	-0.680	0.000	0.000
12.596	3.054	-0.680	4.080	2.478
12.599	2.996	-0.680	0.000	0.000
12.602	2.937	-0.680	0.000	0.000
12.605	2.879	-0.680	0.000	0.000
12.608	2.821	-0.680	0.000	0.000
12.611	2.763	-0.680	0.000	0.000

12.614	2.705	-0.680	0.000	0.000
12.616	2.647	-0.680	3.935	3.207
12.619	2.588	-0.680	0.000	0.000
12.622	2.530	-0.680	4.809	4.374
12.625	2.472	-0.680	4.372	3.936
12.628	2.414	-0.680	0.000	0.000
12.631	2.356	-0.680	0.000	0.000
12.634	2.298	-0.680	5.683	5.103
12.637	2.239	-0.680	0.000	0.000
12.640	2.181	-0.680	0.000	0.000
12.643	2.123	-0.680	4.872	5.636
12.646	2.065	-0.680	0.000	0.000
12.649	2.007	-0.680	0.000	0.000
12.652	1.949	-0.680	3.654	5.484
12.655	1.890	-0.680	0.000	0.000
12.658	1.832	-0.680	3.806	5.636
12.660	1.774	-0.680	4.263	7.312
12.663	1.716	-0.680	3.806	6.398
12.666	1.658	-0.680	0.000	0.000
12.669	1.600	-0.680	3.350	7.007
12.672	1.541	-0.680	1.218	7.769
12.675	1.483	-0.680	0.914	6.550
12.678	1.425	-0.680	0.609	6.855
12.681	1.367	-0.680	0.000	0.000
12.684	1.309	-0.680	0.457	7.616
12.687	1.251	-0.680	0.000	0.000
12.690	1.192	-0.680	0.000	0.000
12.693	1.134	-0.680	0.000	0.000
12.696	1.076	-0.680	-2.436	6.093
12.699	1.018	-0.680	-3.197	6.702
12.702	0.960	-0.680	0.000	0.000
12.705	0.902	-0.680	-3.045	5.027
12.707	0.843	-0.680	0.000	0.000
12.710	0.785	-0.680	0.914	2.894
12.713	0.727	-0.680	0.000	0.000
12.716	0.669	-0.680	0.000	0.000
12.719	0.611	-0.680	0.000	0.000
12.567	3.635	-0.738	0.000	0.000
12.570	3.577	-0.738	0.000	0.000
12.572	3.519	-0.738	3.352	1.895
12.575	3.461	-0.738	0.000	0.000
12.578	3.403	-0.738	4.517	2.333
12.581	3.345	-0.738	0.000	0.000
12.584	3.286	-0.738	3.789	2.916
12.587	3.228	-0.738	3.643	2.770
12.590	3.170	-0.738	0.000	0.000
12.593	3.112	-0.738	3.935	3.062
12.596	3.054	-0.738	0.000	0.000
12.599	2.996	-0.738	5.683	3.353
12.602	2.937	-0.738	5.246	3.791
12.605	2.879	-0.738	0.000	0.000
12.608	2.821	-0.738	4.226	3.645
12.611	2.763	-0.738	0.000	0.000
12.614	2.705	-0.738	0.000	0.000

12.616	2.647	-0.738	5.392	5.103
12.619	2.588	-0.738	0.000	0.000
12.622	2.530	-0.738	0.000	0.000
12.625	2.472	-0.738	4.372	3.791
12.628	2.414	-0.738	0.000	0.000
12.631	2.356	-0.738	0.000	0.000
12.634	2.298	-0.738	0.000	0.000
12.637	2.239	-0.738	5.829	5.249
12.640	2.181	-0.738	6.558	7.581
12.643	2.123	-0.738	0.000	0.000
12.646	2.065	-0.738	0.000	0.000
12.649	2.007	-0.738	5.329	6.855
12.652	1.949	-0.738	0.000	0.000
12.655	1.890	-0.738	0.000	0.000
12.658	1.832	-0.738	0.000	0.000
12.660	1.774	-0.738	0.000	0.000
12.663	1.716	-0.738	0.000	0.000
12.666	1.658	-0.738	2.588	7.921
12.669	1.600	-0.738	0.000	0.000
12.672	1.541	-0.738	0.000	0.000
12.675	1.483	-0.738	0.000	0.000
12.678	1.425	-0.738	0.000	0.000
12.681	1.367	-0.738	-1.827	6.093
12.684	1.309	-0.738	-2.132	7.464
12.687	1.251	-0.738	0.000	0.000
12.690	1.192	-0.738	-2.741	5.636
12.693	1.134	-0.738	-2.132	6.245
12.696	1.076	-0.738	0.000	0.000
12.699	1.018	-0.738	-4.568	7.007
12.702	0.960	-0.738	-5.177	6.702
12.705	0.902	-0.738	0.000	0.000
12.707	0.843	-0.738	-3.502	5.331
12.710	0.785	-0.738	0.000	0.000
12.713	0.727	-0.738	0.000	0.000
12.716	0.669	-0.738	0.152	3.351
12.719	0.611	-0.738	-3.045	2.285
12.567	3.635	-0.797	0.000	0.000
12.570	3.577	-0.797	4.226	2.333
12.572	3.519	-0.797	3.643	-1.458
12.575	3.461	-0.797	0.000	0.000
12.578	3.403	-0.797	3.206	2.624
12.581	3.345	-0.797	2.914	1.895
12.584	3.286	-0.797	0.000	0.000
12.587	3.228	-0.797	0.000	0.000
12.590	3.170	-0.797	0.000	0.000
12.593	3.112	-0.797	0.000	0.000
12.596	3.054	-0.797	0.000	0.000
12.599	2.996	-0.797	0.000	0.000
12.602	2.937	-0.797	4.226	3.062
12.605	2.879	-0.797	5.100	3.353
12.608	2.821	-0.797	0.000	0.000
12.611	2.763	-0.797	5.100	4.082
12.614	2.705	-0.797	0.000	0.000
12.616	2.647	-0.797	0.000	0.000

12.619	2.588	-0.797	4.517	3.936
12.622	2.530	-0.797	0.000	0.000
12.625	2.472	-0.797	5.100	4.957
12.628	2.414	-0.797	3.352	3.791
12.631	2.356	-0.797	0.000	0.000
12.634	2.298	-0.797	0.000	0.000
12.637	2.239	-0.797	0.000	0.000
12.640	2.181	-0.797	0.000	0.000
12.643	2.123	-0.797	4.415	5.636
12.646	2.065	-0.797	0.000	0.000
12.649	2.007	-0.797	3.806	6.855
12.652	1.949	-0.797	0.000	0.000
12.655	1.890	-0.797	2.588	5.788
12.658	1.832	-0.797	0.000	0.000
12.660	1.774	-0.797	2.132	7.007
12.663	1.716	-0.797	0.000	0.000
12.666	1.658	-0.797	0.000	0.000
12.669	1.600	-0.797	1.066	8.530
12.672	1.541	-0.797	0.000	0.000
12.675	1.483	-0.797	0.761	6.702
12.678	1.425	-0.797	0.152	6.093
12.681	1.367	-0.797	0.000	0.000
12.684	1.309	-0.797	0.000	0.000
12.687	1.251	-0.797	-2.132	7.007
12.690	1.192	-0.797	0.000	0.000
12.693	1.134	-0.797	0.000	0.000
12.696	1.076	-0.797	-3.350	6.245
12.699	1.018	-0.797	0.000	0.000
12.702	0.960	-0.797	-3.502	5.179
12.705	0.902	-0.797	0.000	0.000
12.707	0.843	-0.797	0.000	0.000
12.710	0.785	-0.797	-4.872	5.941
12.713	0.727	-0.797	-4.720	5.179
12.716	0.669	-0.797	2.436	3.504
12.719	0.611	-0.797	0.000	0.000
12.567	3.635	-0.855	0.000	0.000
12.570	3.577	-0.855	3.206	-1.604
12.572	3.519	-0.855	0.000	0.000
12.575	3.461	-0.855	0.000	0.000
12.578	3.403	-0.855	3.206	2.187
12.581	3.345	-0.855	3.935	2.624
12.584	3.286	-0.855	0.000	0.000
12.587	3.228	-0.855	4.080	2.916
12.590	3.170	-0.855	3.497	2.624
12.593	3.112	-0.855	3.935	2.478
12.596	3.054	-0.855	4.372	2.916
12.599	2.996	-0.855	3.789	4.082
12.602	2.937	-0.855	0.000	0.000
12.605	2.879	-0.855	3.206	3.353
12.608	2.821	-0.855	3.789	3.207
12.611	2.763	-0.855	0.000	0.000
12.614	2.705	-0.855	4.809	4.520
12.616	2.647	-0.855	0.000	0.000
12.619	2.588	-0.855	4.517	4.520

12.622	2.530	-0.855	4.517	4.665
12.625	2.472	-0.855	0.000	0.000
12.628	2.414	-0.855	0.000	0.000
12.631	2.356	-0.855	2.769	4.082
12.634	2.298	-0.855	0.000	0.000
12.637	2.239	-0.855	4.663	4.665
12.640	2.181	-0.855	0.000	0.000
12.643	2.123	-0.855	0.000	0.000
12.646	2.065	-0.855	0.000	0.000
12.649	2.007	-0.855	0.000	0.000
12.652	1.949	-0.855	3.350	4.874
12.655	1.890	-0.855	0.000	0.000
12.658	1.832	-0.855	0.000	0.000
12.660	1.774	-0.855	0.000	0.000
12.663	1.716	-0.855	0.000	0.000
12.666	1.658	-0.855	0.000	0.000
12.669	1.600	-0.855	0.000	0.000
12.672	1.541	-0.855	0.000	0.000
12.675	1.483	-0.855	0.761	7.921
12.678	1.425	-0.855	-0.152	6.093
12.681	1.367	-0.855	0.000	0.000
12.684	1.309	-0.855	0.000	0.000
12.687	1.251	-0.855	-2.741	5.484
12.690	1.192	-0.855	0.000	0.000
12.693	1.134	-0.855	-2.132	5.484
12.696	1.076	-0.855	0.000	0.000
12.699	1.018	-0.855	0.000	0.000
12.702	0.960	-0.855	-3.806	5.788
12.705	0.902	-0.855	0.000	0.000
12.707	0.843	-0.855	-4.872	7.159
12.710	0.785	-0.855	-4.720	6.093
12.713	0.727	-0.855	0.000	0.000
12.716	0.669	-0.855	0.000	0.000
12.719	0.611	-0.855	-3.806	5.027
12.567	3.635	-0.913	0.000	0.000
12.570	3.577	-0.913	3.935	2.041
12.572	3.519	-0.913	0.000	0.000
12.575	3.461	-0.913	3.352	2.187
12.578	3.403	-0.913	0.000	0.000
12.581	3.345	-0.913	3.497	2.333
12.584	3.286	-0.913	0.000	0.000
12.587	3.228	-0.913	0.000	0.000
12.590	3.170	-0.913	3.497	2.916
12.593	3.112	-0.913	0.000	0.000
12.596	3.054	-0.913	0.000	0.000
12.599	2.996	-0.913	0.000	0.000
12.602	2.937	-0.913	4.663	4.228
12.605	2.879	-0.913	4.080	3.207
12.608	2.821	-0.913	0.000	0.000
12.611	2.763	-0.913	0.000	0.000
12.614	2.705	-0.913	0.000	0.000
12.616	2.647	-0.913	3.935	3.791
12.619	2.588	-0.913	0.000	0.000
12.622	2.530	-0.913	3.643	3.791

12.625	2.472	-0.913	0.000	0.000
12.628	2.414	-0.913	3.789	4.665
12.631	2.356	-0.913	0.000	0.000
12.634	2.298	-0.913	4.809	5.832
12.637	2.239	-0.913	0.000	0.000
12.640	2.181	-0.913	3.206	4.665
12.643	2.123	-0.913	0.000	0.000
12.646	2.065	-0.913	4.415	4.874
12.649	2.007	-0.913	3.806	5.788
12.652	1.949	-0.913	2.588	6.093
12.655	1.890	-0.913	0.000	0.000
12.658	1.832	-0.913	2.132	6.702
12.660	1.774	-0.913	0.000	0.000
12.663	1.716	-0.913	0.000	0.000
12.666	1.658	-0.913	0.761	6.245
12.669	1.600	-0.913	1.370	6.398
12.672	1.541	-0.913	1.370	6.398
12.675	1.483	-0.913	0.000	0.000
12.678	1.425	-0.913	0.000	0.000
12.681	1.367	-0.913	-0.914	7.007
12.684	1.309	-0.913	0.000	0.000
12.687	1.251	-0.913	0.000	0.000
12.690	1.192	-0.913	0.000	0.000
12.693	1.134	-0.913	0.000	0.000
12.696	1.076	-0.913	0.000	0.000
12.699	1.018	-0.913	-3.350	5.941
12.702	0.960	-0.913	0.000	0.000
12.705	0.902	-0.913	0.000	0.000
12.707	0.843	-0.913	0.000	0.000
12.710	0.785	-0.913	0.000	0.000
12.713	0.727	-0.913	0.000	0.000
12.716	0.669	-0.913	-5.481	5.788
12.719	0.611	-0.913	0.000	0.000
12.567	3.635	-0.971	0.000	0.000
12.570	3.577	-0.971	0.000	0.000
12.572	3.519	-0.971	0.000	0.000
12.575	3.461	-0.971	0.000	0.000
12.578	3.403	-0.971	0.000	0.000
12.581	3.345	-0.971	5.246	3.936
12.584	3.286	-0.971	3.935	2.770
12.587	3.228	-0.971	0.000	0.000
12.590	3.170	-0.971	0.000	0.000
12.593	3.112	-0.971	0.000	0.000
12.596	3.054	-0.971	3.789	3.499
12.599	2.996	-0.971	0.000	0.000
12.602	2.937	-0.971	4.663	3.936
12.605	2.879	-0.971	4.226	4.082
12.608	2.821	-0.971	4.080	4.082
12.611	2.763	-0.971	4.080	3.645
12.614	2.705	-0.971	3.643	3.791
12.616	2.647	-0.971	0.000	0.000
12.619	2.588	-0.971	4.517	4.665
12.622	2.530	-0.971	0.000	0.000
12.625	2.472	-0.971	0.000	0.000

12.628	2.414	-0.971	4.372	5.103
12.631	2.356	-0.971	0.000	0.000
12.634	2.298	-0.971	0.000	0.000
12.637	2.239	-0.971	3.497	4.811
12.640	2.181	-0.971	0.000	0.000
12.643	2.123	-0.971	3.806	6.245
12.646	2.065	-0.971	0.000	0.000
12.649	2.007	-0.971	0.000	0.000
12.652	1.949	-0.971	0.000	0.000
12.655	1.890	-0.971	2.893	6.550
12.658	1.832	-0.971	0.000	0.000
12.660	1.774	-0.971	0.000	0.000
12.663	1.716	-0.971	2.284	7.769
12.666	1.658	-0.971	1.675	6.550
12.669	1.600	-0.971	0.000	0.000
12.672	1.541	-0.971	0.000	0.000
12.675	1.483	-0.971	-0.152	7.007
12.678	1.425	-0.971	0.000	0.000
12.681	1.367	-0.971	0.000	0.000
12.684	1.309	-0.971	-0.152	6.855
12.687	1.251	-0.971	0.000	0.000
12.690	1.192	-0.971	-1.218	7.159
12.693	1.134	-0.971	-0.761	5.484
12.696	1.076	-0.971	0.000	0.000
12.699	1.018	-0.971	0.000	0.000
12.702	0.960	-0.971	-3.197	6.550
12.705	0.902	-0.971	0.000	0.000
12.707	0.843	-0.971	-3.654	5.788
12.710	0.785	-0.971	0.000	0.000
12.713	0.727	-0.971	-4.415	4.874
12.716	0.669	-0.971	-4.415	6.093
12.719	0.611	-0.971	0.000	0.000
12.567	3.635	-1.029	0.000	0.000
12.570	3.577	-1.029	3.060	2.041
12.572	3.519	-1.029	3.352	2.478
12.575	3.461	-1.029	3.206	1.895
12.578	3.403	-1.029	0.000	0.000
12.581	3.345	-1.029	0.000	0.000
12.584	3.286	-1.029	0.000	0.000
12.587	3.228	-1.029	0.000	0.000
12.590	3.170	-1.029	4.226	2.916
12.593	3.112	-1.029	0.000	0.000
12.596	3.054	-1.029	4.226	3.645
12.599	2.996	-1.029	0.000	0.000
12.602	2.937	-1.029	0.000	0.000
12.605	2.879	-1.029	0.000	0.000
12.608	2.821	-1.029	0.000	0.000
12.611	2.763	-1.029	0.000	0.000
12.614	2.705	-1.029	0.000	0.000
12.616	2.647	-1.029	3.935	3.499
12.619	2.588	-1.029	0.000	0.000
12.622	2.530	-1.029	2.914	4.665
12.625	2.472	-1.029	0.000	0.000
12.628	2.414	-1.029	0.000	0.000

12.631	2.356	-1.029	0.000	0.000
12.634	2.298	-1.029	0.000	0.000
12.637	2.239	-1.029	0.000	0.000
12.640	2.181	-1.029	3.643	5.832
12.643	2.123	-1.029	0.000	0.000
12.646	2.065	-1.029	0.000	0.000
12.649	2.007	-1.029	0.000	0.000
12.652	1.949	-1.029	0.000	0.000
12.655	1.890	-1.029	0.000	0.000
12.658	1.832	-1.029	2.132	7.159
12.660	1.774	-1.029	0.000	0.000
12.663	1.716	-1.029	1.523	6.245
12.666	1.658	-1.029	0.000	6.550
12.669	1.600	-1.029	0.000	0.000
12.672	1.541	-1.029	0.000	0.000
12.675	1.483	-1.029	0.000	0.000
12.678	1.425	-1.029	-0.457	7.616
12.681	1.367	-1.029	0.000	0.000
12.684	1.309	-1.029	0.304	6.550
12.687	1.251	-1.029	-1.979	5.788
12.690	1.192	-1.029	0.000	0.000
12.693	1.134	-1.029	-2.284	6.245
12.696	1.076	-1.029	0.000	0.000
12.699	1.018	-1.029	0.000	0.000
12.702	0.960	-1.029	0.000	0.000
12.705	0.902	-1.029	-3.350	5.027
12.707	0.843	-1.029	0.000	0.000
12.710	0.785	-1.029	-5.329	6.093
12.713	0.727	-1.029	0.000	0.000
12.716	0.669	-1.029	0.000	0.000
12.719	0.611	-1.029	0.000	0.000
12.567	3.635	-1.088	0.000	0.000
12.570	3.577	-1.088	3.206	2.333
12.572	3.519	-1.088	3.206	2.624
12.575	3.461	-1.088	0.000	0.000
12.578	3.403	-1.088	3.643	2.916
12.581	3.345	-1.088	3.789	3.645
12.584	3.286	-1.088	0.000	0.000
12.587	3.228	-1.088	3.789	3.936
12.590	3.170	-1.088	4.080	3.207
12.593	3.112	-1.088	0.000	0.000
12.596	3.054	-1.088	0.000	0.000
12.599	2.996	-1.088	4.663	4.374
12.602	2.937	-1.088	0.000	0.000
12.605	2.879	-1.088	3.789	3.499
12.608	2.821	-1.088	3.935	4.228
12.611	2.763	-1.088	0.000	0.000
12.614	2.705	-1.088	4.226	4.520
12.616	2.647	-1.088	0.000	0.000
12.619	2.588	-1.088	0.000	0.000
12.622	2.530	-1.088	0.000	0.000
12.625	2.472	-1.088	3.643	4.811
12.628	2.414	-1.088	0.000	0.000
12.631	2.356	-1.088	3.935	5.832

12.634	2.298	-1.088	3.352	5.249
12.637	2.239	-1.088	0.000	0.000
12.640	2.181	-1.088	0.000	0.000
12.643	2.123	-1.088	2.914	5.103
12.646	2.065	-1.088	3.350	6.702
12.649	2.007	-1.088	2.588	6.702
12.652	1.949	-1.088	0.000	0.000
12.655	1.890	-1.088	0.000	0.000
12.658	1.832	-1.088	0.000	0.000
12.660	1.774	-1.088	0.000	0.000
12.663	1.716	-1.088	0.000	0.000
12.666	1.658	-1.088	0.000	0.000
12.669	1.600	-1.088	0.000	0.000
12.672	1.541	-1.088	0.152	6.702
12.675	1.483	-1.088	0.000	0.000
12.678	1.425	-1.088	0.000	0.000
12.681	1.367	-1.088	0.000	0.000
12.684	1.309	-1.088	-2.132	6.855
12.687	1.251	-1.088	0.000	0.000
12.690	1.192	-1.088	-1.979	6.855
12.693	1.134	-1.088	0.000	0.000
12.696	1.076	-1.088	0.000	0.000
12.699	1.018	-1.088	-3.045	6.093
12.702	0.960	-1.088	0.000	0.000
12.705	0.902	-1.088	0.000	0.000
12.707	0.843	-1.088	0.000	0.000
12.710	0.785	-1.088	-3.502	5.788
12.713	0.727	-1.088	0.000	0.000
12.716	0.669	-1.088	-5.177	5.484
12.719	0.611	-1.088	0.000	0.000
12.567	3.635	-1.146	2.623	-1.458
12.570	3.577	-1.146	0.000	0.000
12.572	3.519	-1.146	0.000	0.000
12.575	3.461	-1.146	0.000	0.000
12.578	3.403	-1.146	0.000	0.000
12.581	3.345	-1.146	0.000	0.000
12.584	3.286	-1.146	0.000	0.000
12.587	3.228	-1.146	3.206	2.624
12.590	3.170	-1.146	0.000	0.000
12.593	3.112	-1.146	3.352	3.062
12.596	3.054	-1.146	9.101	9.561
12.599	2.996	-1.146	3.497	3.499
12.602	2.937	-1.146	0.000	0.000
12.605	2.879	-1.146	0.000	0.000
12.608	2.821	-1.146	0.000	0.000
12.611	2.763	-1.146	0.000	0.000
12.614	2.705	-1.146	3.643	4.520
12.616	2.647	-1.146	3.060	3.791
12.619	2.588	-1.146	0.000	0.000
12.622	2.530	-1.146	0.000	0.000
12.625	2.472	-1.146	0.000	0.000
12.628	2.414	-1.146	3.789	5.249
12.631	2.356	-1.146	0.000	0.000
12.634	2.298	-1.146	0.000	0.000

12.637	2.239	-1.146	0.000	0.000
12.640	2.181	-1.146	0.000	0.000
12.643	2.123	-1.146	0.000	0.000
12.646	2.065	-1.146	0.000	0.000
12.649	2.007	-1.146	0.000	0.000
12.652	1.949	-1.146	2.284	6.093
12.655	1.890	-1.146	0.000	0.000
12.658	1.832	-1.146	0.000	0.000
12.660	1.774	-1.146	0.000	0.000
12.663	1.716	-1.146	0.000	0.000
12.666	1.658	-1.146	0.914	7.616
12.669	1.600	-1.146	0.609	6.245
12.672	1.541	-1.146	0.000	0.000
12.675	1.483	-1.146	0.000	0.000
12.678	1.425	-1.146	0.000	0.000
12.681	1.367	-1.146	0.000	0.000
12.684	1.309	-1.146	0.000	0.000
12.687	1.251	-1.146	0.000	0.000
12.690	1.192	-1.146	0.000	0.000
12.693	1.134	-1.146	0.000	0.000
12.696	1.076	-1.146	-3.350	6.855
12.699	1.018	-1.146	-3.350	7.312
12.702	0.960	-1.146	0.000	0.000
12.705	0.902	-1.146	-3.502	7.464
12.707	0.843	-1.146	0.000	0.000
12.710	0.785	-1.146	0.000	0.000
12.713	0.727	-1.146	-3.959	5.331
12.716	0.669	-1.146	0.000	0.000
12.719	0.611	-1.146	-4.720	5.941
12.567	3.635	-1.204	0.000	0.000
12.570	3.577	-1.204	3.643	2.333
12.572	3.519	-1.204	0.000	0.000
12.575	3.461	-1.204	3.206	2.624
12.578	3.403	-1.204	3.789	3.207
12.581	3.345	-1.204	4.080	3.936
12.584	3.286	-1.204	0.000	0.000
12.587	3.228	-1.204	0.000	0.000
12.590	3.170	-1.204	0.000	0.000
12.593	3.112	-1.204	0.000	0.000
12.596	3.054	-1.204	0.000	0.000
12.599	2.996	-1.204	0.000	0.000
12.602	2.937	-1.204	2.914	3.499
12.605	2.879	-1.204	0.000	0.000
12.608	2.821	-1.204	2.914	3.499
12.611	2.763	-1.204	0.000	0.000
12.614	2.705	-1.204	0.000	0.000
12.616	2.647	-1.204	2.477	2.624
12.619	2.588	-1.204	4.372	4.374
12.622	2.530	-1.204	0.000	0.000
12.625	2.472	-1.204	0.000	0.000
12.628	2.414	-1.204	0.000	0.000
12.631	2.356	-1.204	2.769	4.665
12.634	2.298	-1.204	3.060	4.228
12.637	2.239	-1.204	2.186	3.791

12.640	2.181	-1.204	2.769	4.665
12.643	2.123	-1.204	0.000	0.000
12.646	2.065	-1.204	0.000	0.000
12.649	2.007	-1.204	2.132	5.636
12.652	1.949	-1.204	0.000	0.000
12.655	1.890	-1.204	0.914	5.331
12.658	1.832	-1.204	0.000	0.000
12.660	1.774	-1.204	1.066	5.788
12.663	1.716	-1.204	0.000	0.000
12.666	1.658	-1.204	0.000	0.000
12.669	1.600	-1.204	0.609	7.312
12.672	1.541	-1.204	0.000	0.000
12.675	1.483	-1.204	-0.457	6.245
12.678	1.425	-1.204	-1.523	6.398
12.681	1.367	-1.204	-1.066	6.398
12.684	1.309	-1.204	0.000	0.000
12.687	1.251	-1.204	-2.132	8.835
12.690	1.192	-1.204	0.000	0.000
12.693	1.134	-1.204	-1.827	7.312
12.696	1.076	-1.204	0.000	0.000
12.699	1.018	-1.204	0.000	0.000
12.702	0.960	-1.204	0.000	0.000
12.705	0.902	-1.204	0.000	0.000
12.707	0.843	-1.204	0.000	0.000
12.710	0.785	-1.204	-4.111	5.941
12.713	0.727	-1.204	0.000	0.000
12.716	0.669	-1.204	0.000	0.000
12.719	0.611	-1.204	-5.024	5.484
12.567	3.635	-1.262	0.000	0.000
12.570	3.577	-1.262	0.000	0.000
12.572	3.519	-1.262	3.352	2.770
12.575	3.461	-1.262	2.914	2.478
12.578	3.403	-1.262	0.000	0.000
12.581	3.345	-1.262	3.060	3.207
12.584	3.286	-1.262	0.000	0.000
12.587	3.228	-1.262	3.206	3.062
12.590	3.170	-1.262	2.914	3.062
12.593	3.112	-1.262	3.060	2.916
12.596	3.054	-1.262	2.810	3.749
12.599	2.996	-1.262	0.000	0.000
12.602	2.937	-1.262	2.914	4.374
12.605	2.879	-1.262	3.060	3.791
12.608	2.821	-1.262	0.000	0.000
12.611	2.763	-1.262	0.000	0.000
12.614	2.705	-1.262	0.000	0.000
12.616	2.647	-1.262	0.000	0.000
12.619	2.588	-1.262	0.000	0.000
12.622	2.530	-1.262	3.497	4.374
12.625	2.472	-1.262	0.000	0.000
12.628	2.414	-1.262	2.623	4.811
12.631	2.356	-1.262	0.000	0.000
12.634	2.298	-1.262	0.000	0.000
12.637	2.239	-1.262	0.000	0.000
12.640	2.181	-1.262	1.894	4.811

12.643	2.123	-1.262	0.000	0.000
12.646	2.065	-1.262	0.000	0.000
12.649	2.007	-1.262	0.000	0.000
12.652	1.949	-1.262	2.588	7.159
12.655	1.890	-1.262	0.000	0.000
12.658	1.832	-1.262	0.000	0.000
12.660	1.774	-1.262	1.066	7.464
12.663	1.716	-1.262	0.000	0.000
12.666	1.658	-1.262	0.000	0.000
12.669	1.600	-1.262	0.000	0.000
12.672	1.541	-1.262	0.000	0.000
12.675	1.483	-1.262	0.000	0.000
12.678	1.425	-1.262	0.000	0.000
12.681	1.367	-1.262	0.000	0.000
12.684	1.309	-1.262	0.000	0.000
12.687	1.251	-1.262	0.000	0.000
12.690	1.192	-1.262	0.000	0.000
12.693	1.134	-1.262	0.000	0.000
12.696	1.076	-1.262	0.000	0.000
12.699	1.018	-1.262	-3.350	7.159
12.702	0.960	-1.262	-3.350	7.007
12.705	0.902	-1.262	0.000	0.000
12.707	0.843	-1.262	-3.959	6.398
12.710	0.785	-1.262	-3.959	5.484
12.713	0.727	-1.262	0.000	0.000
12.716	0.669	-1.262	0.000	0.000
12.719	0.611	-1.262	0.000	0.000
12.567	3.635	-1.321	0.000	0.000
12.570	3.577	-1.321	3.060	2.624
12.572	3.519	-1.321	0.000	0.000
12.575	3.461	-1.321	3.497	2.916
12.578	3.403	-1.321	0.000	0.000
12.581	3.345	-1.321	2.914	2.916
12.584	3.286	-1.321	3.643	2.624
12.587	3.228	-1.321	0.000	0.000
12.590	3.170	-1.321	0.000	0.000
12.593	3.112	-1.321	0.000	0.000
12.596	3.054	-1.321	2.769	3.353
12.599	2.996	-1.321	0.000	0.000
12.602	2.937	-1.321	0.000	0.000
12.605	2.879	-1.321	0.000	0.000
12.608	2.821	-1.321	0.000	0.000
12.611	2.763	-1.321	3.789	4.520
12.614	2.705	-1.321	3.206	4.957
12.616	2.647	-1.321	0.000	0.000
12.619	2.588	-1.321	0.000	0.000
12.622	2.530	-1.321	0.000	0.000
12.625	2.472	-1.321	0.000	0.000
12.628	2.414	-1.321	0.000	0.000
12.631	2.356	-1.321	0.000	0.000
12.634	2.298	-1.321	0.000	0.000
12.637	2.239	-1.321	3.060	5.394
12.640	2.181	-1.321	2.914	6.269
12.643	2.123	-1.321	0.000	0.000

12.646	2.065	-1.321	2.588	6.702
12.649	2.007	-1.321	2.588	6.398
12.652	1.949	-1.321	0.000	0.000
12.655	1.890	-1.321	1.827	7.616
12.658	1.832	-1.321	0.000	0.000
12.660	1.774	-1.321	0.000	0.000
12.663	1.716	-1.321	0.000	0.000
12.666	1.658	-1.321	0.761	7.616
12.669	1.600	-1.321	0.000	0.000
12.672	1.541	-1.321	0.761	7.159
12.675	1.483	-1.321	0.000	0.000
12.678	1.425	-1.321	0.000	0.000
12.681	1.367	-1.321	0.000	0.000
12.684	1.309	-1.321	-1.675	5.331
12.687	1.251	-1.321	0.000	0.000
12.690	1.192	-1.321	0.000	0.000
12.693	1.134	-1.321	-2.436	6.245
12.696	1.076	-1.321	-2.893	5.636
12.699	1.018	-1.321	0.000	0.000
12.702	0.960	-1.321	-3.959	6.093
12.705	0.902	-1.321	0.000	0.000
12.707	0.843	-1.321	0.000	0.000
12.710	0.785	-1.321	0.000	0.000
12.713	0.727	-1.321	0.000	0.000
12.716	0.669	-1.321	-4.415	5.484
12.719	0.611	-1.321	0.000	0.000
12.567	3.635	-1.379	0.000	0.000
12.570	3.577	-1.379	3.352	2.916
12.572	3.519	-1.379	3.352	2.478
12.575	3.461	-1.379	0.000	0.000
12.578	3.403	-1.379	2.914	2.770
12.581	3.345	-1.379	0.000	0.000
12.584	3.286	-1.379	2.914	3.207
12.587	3.228	-1.379	2.769	3.207
12.590	3.170	-1.379	2.914	3.062
12.593	3.112	-1.379	3.060	3.353
12.596	3.054	-1.379	0.000	0.000
12.599	2.996	-1.379	0.000	0.000
12.602	2.937	-1.379	0.000	0.000
12.605	2.879	-1.379	0.000	0.000
12.608	2.821	-1.379	0.000	0.000
12.611	2.763	-1.379	0.000	0.000
12.614	2.705	-1.379	0.000	0.000
12.616	2.647	-1.379	0.000	0.000
12.619	2.588	-1.379	0.000	0.000
12.622	2.530	-1.379	2.914	4.082
12.625	2.472	-1.379	2.477	4.520
12.628	2.414	-1.379	2.477	4.520
12.631	2.356	-1.379	0.000	0.000
12.634	2.298	-1.379	2.040	4.665
12.637	2.239	-1.379	0.000	0.000
12.640	2.181	-1.379	0.000	0.000
12.643	2.123	-1.379	3.045	6.550
12.646	2.065	-1.379	0.000	0.000

12.649	2.007	-1.379	0.000	0.000
12.652	1.949	-1.379	0.000	0.000
12.655	1.890	-1.379	0.000	0.000
12.658	1.832	-1.379	0.000	0.000
12.660	1.774	-1.379	0.000	0.000
12.663	1.716	-1.379	0.000	0.000
12.666	1.658	-1.379	0.000	0.000
12.669	1.600	-1.379	0.152	7.159
12.672	1.541	-1.379	0.000	0.000
12.675	1.483	-1.379	-0.305	5.484
12.678	1.425	-1.379	-0.609	6.855
12.681	1.367	-1.379	-0.761	7.007
12.684	1.309	-1.379	0.000	0.000
12.687	1.251	-1.379	0.000	0.000
12.690	1.192	-1.379	0.000	0.000
12.693	1.134	-1.379	-2.741	6.855
12.696	1.076	-1.379	0.000	0.000
12.699	1.018	-1.379	-2.741	4.874
12.702	0.960	-1.379	0.000	0.000
12.705	0.902	-1.379	0.000	0.000
12.707	0.843	-1.379	0.000	0.000
12.710	0.785	-1.379	-3.197	5.484
12.713	0.727	-1.379	-4.372	5.936
12.716	0.669	-1.379	0.000	0.000
12.719	0.611	-1.379	-4.263	5.484
12.567	3.635	-1.437	0.000	0.000
12.570	3.577	-1.437	0.000	0.000
12.572	3.519	-1.437	0.000	0.000
12.575	3.461	-1.437	0.000	0.000
12.578	3.403	-1.437	3.123	4.061
12.581	3.345	-1.437	0.000	0.000
12.584	3.286	-1.437	0.000	0.000
12.587	3.228	-1.437	2.477	3.645
12.590	3.170	-1.437	2.623	3.207
12.593	3.112	-1.437	0.000	0.000
12.596	3.054	-1.437	0.000	0.000
12.599	2.996	-1.437	0.000	0.000
12.602	2.937	-1.437	0.000	0.000
12.605	2.879	-1.437	0.000	0.000
12.608	2.821	-1.437	0.000	0.000
12.611	2.763	-1.437	0.000	0.000
12.614	2.705	-1.437	0.000	0.000
12.616	2.647	-1.437	2.332	4.082
12.619	2.588	-1.437	0.000	0.000
12.622	2.530	-1.437	0.000	0.000
12.625	2.472	-1.437	0.000	0.000
12.628	2.414	-1.437	2.332	4.957
12.631	2.356	-1.437	1.749	3.645
12.634	2.298	-1.437	1.749	4.082
12.637	2.239	-1.437	0.000	0.000
12.640	2.181	-1.437	0.000	0.000
12.643	2.123	-1.437	0.000	0.000
12.646	2.065	-1.437	2.132	7.616
12.649	2.007	-1.437	1.218	6.398

12.652	1.949	-1.437	2.132	7.007
12.655	1.890	-1.437	1.675	7.769
12.658	1.832	-1.437	0.000	0.000
12.660	1.774	-1.437	0.000	0.000
12.663	1.716	-1.437	0.457	6.245
12.666	1.658	-1.437	0.000	0.000
12.669	1.600	-1.437	-0.609	7.769
12.672	1.541	-1.437	0.000	0.000
12.675	1.483	-1.437	0.000	0.000
12.678	1.425	-1.437	0.000	0.000
12.681	1.367	-1.437	0.000	0.000
12.684	1.309	-1.437	0.000	0.000
12.687	1.251	-1.437	-1.675	5.788
12.690	1.192	-1.437	0.000	0.000
12.693	1.134	-1.437	0.000	0.000
12.696	1.076	-1.437	0.000	0.000
12.699	1.018	-1.437	-2.588	5.941
12.702	0.960	-1.437	-3.350	5.331
12.705	0.902	-1.437	0.000	0.000
12.707	0.843	-1.437	-4.263	5.484
12.710	0.785	-1.437	0.000	0.000
12.713	0.727	-1.437	0.000	0.000
12.716	0.669	-1.437	0.000	0.000
12.719	0.611	-1.437	0.000	0.000
12.567	3.635	-1.495	0.000	0.000
12.570	3.577	-1.495	0.000	0.000
12.572	3.519	-1.495	0.000	0.000
12.575	3.461	-1.495	0.000	0.000
12.578	3.403	-1.495	3.060	3.062
12.581	3.345	-1.495	0.000	0.000
12.584	3.286	-1.495	3.789	3.645
12.587	3.228	-1.495	0.000	0.000
12.590	3.170	-1.495	0.000	0.000
12.593	3.112	-1.495	0.000	0.000
12.596	3.054	-1.495	0.000	0.000
12.599	2.996	-1.495	0.000	0.000
12.602	2.937	-1.495	0.000	0.000
12.605	2.879	-1.495	0.000	0.000
12.608	2.821	-1.495	0.000	0.000
12.611	2.763	-1.495	0.000	0.000
12.614	2.705	-1.495	0.000	0.000
12.616	2.647	-1.495	0.000	0.000
12.619	2.588	-1.495	0.000	0.000
12.622	2.530	-1.495	0.000	0.000
12.625	2.472	-1.495	0.000	0.000
12.628	2.414	-1.495	0.000	0.000
12.631	2.356	-1.495	0.000	0.000
12.634	2.298	-1.495	0.000	0.000
12.637	2.239	-1.495	0.000	0.000
12.640	2.181	-1.495	0.000	0.000
12.643	2.123	-1.495	0.000	0.000
12.646	2.065	-1.495	0.000	0.000
12.649	2.007	-1.495	0.000	0.000
12.652	1.949	-1.495	0.000	0.000

12.655	1.890	-1.495	0.000	0.000
12.658	1.832	-1.495	0.000	0.000
12.660	1.774	-1.495	0.000	0.000
12.663	1.716	-1.495	0.000	0.000
12.666	1.658	-1.495	0.000	0.000
12.669	1.600	-1.495	0.000	0.000
12.672	1.541	-1.495	0.000	0.000
12.675	1.483	-1.495	0.000	0.000
12.678	1.425	-1.495	0.000	0.000
12.681	1.367	-1.495	0.000	0.000
12.684	1.309	-1.495	0.000	0.000
12.687	1.251	-1.495	0.000	0.000
12.690	1.192	-1.495	0.000	0.000
12.693	1.134	-1.495	0.000	0.000
12.696	1.076	-1.495	0.000	0.000
12.699	1.018	-1.495	0.000	0.000
12.702	0.960	-1.495	0.000	0.000
12.705	0.902	-1.495	0.000	0.000
12.707	0.843	-1.495	0.000	0.000
12.710	0.785	-1.495	0.000	0.000
12.713	0.727	-1.495	0.000	0.000
12.716	0.669	-1.495	0.000	0.000
12.719	0.611	-1.495	0.000	0.000

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